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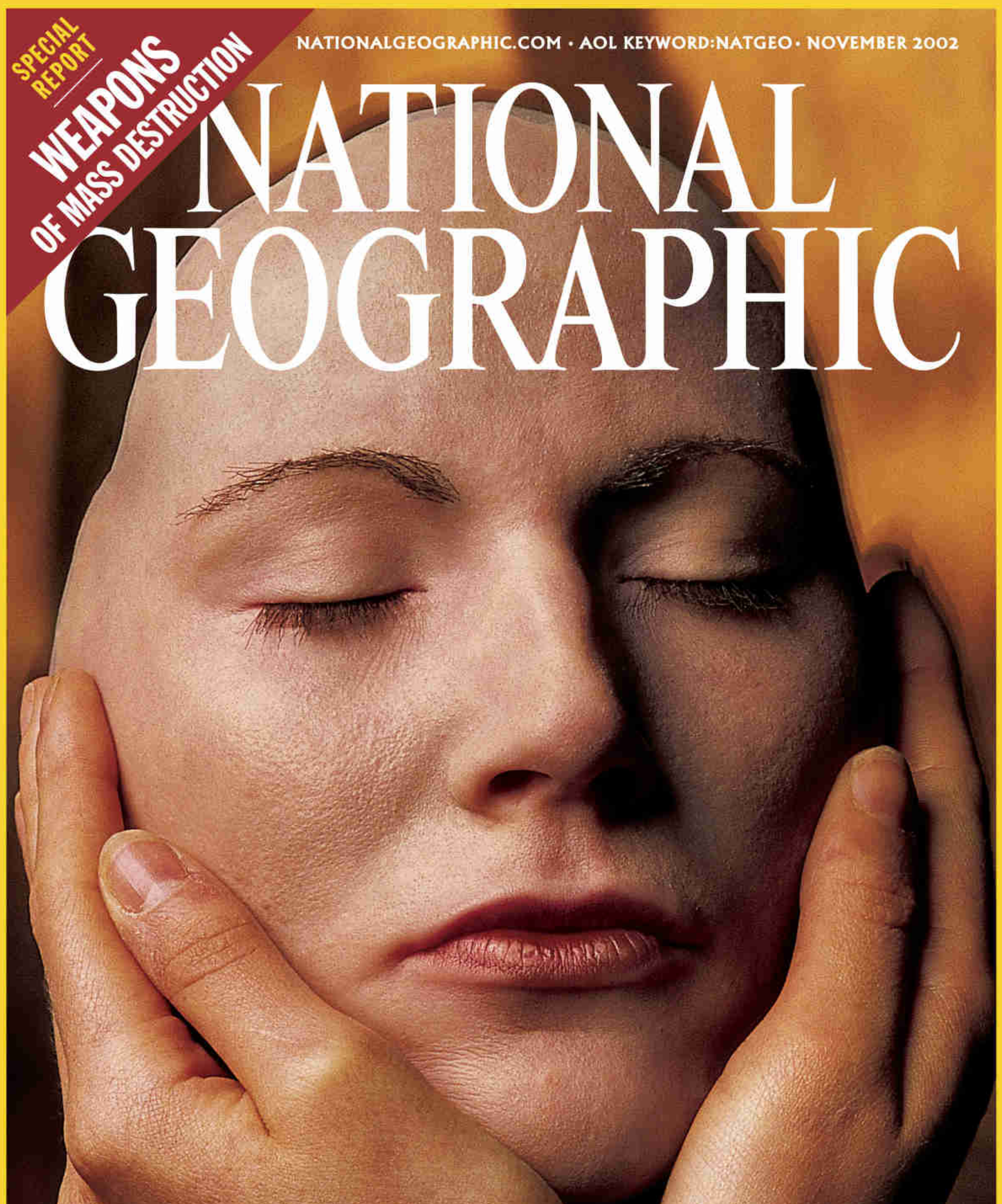
SPECIAL REPORT

WEAPONS OF MASS DESTRUCTION

NATIONAL GEOGRAPHIC



UNMASKING SKIN

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Although it's unlikely you'll ever embark on a cross-continental relay race, isn't it nice to know it wouldn't be a problem? The Nissan Pathfinder. An all-powerful, 240-horsepower 3.5-liter V6 engine instantly tames the most unruly terrain. A commanding 4WD system provides unflinching

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NISSAN

SHIFT_landscapes

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Cotton

*National Center for Food and Agricultural Policy Report.

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INFORMATION

good ideas are growing

VOL. 202 • NO. 5 • NOVEMBER 2002

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THE COVER

The hands are real. The face is silicone, dye, and synthetic hair. Learn more about how this extraordinary mask was created in Behind the Scenes.
BY SARAH LEEN

ON THE NGM WEBSITE

nationalgeographic.com/ngm/0211

SIGHTS & SOUNDS of Ethiopia's geladas: Females rule!
WEAPONS Photographer Lynn Johnson talks about fear.
SKIN How do you photograph 21 square feet of skin?
FORUMS Go ahead, sound off.

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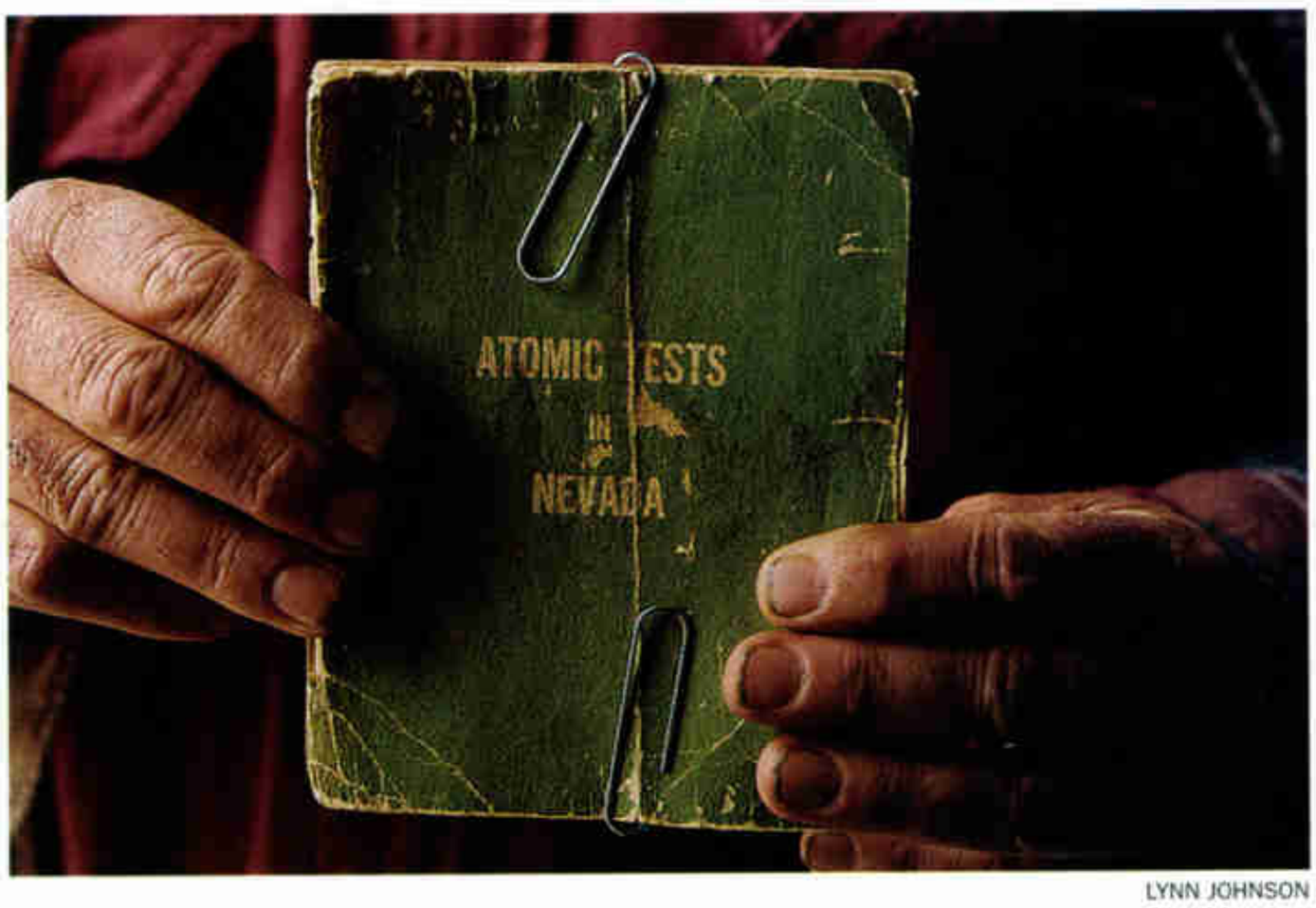
From the Editor



LYNN JOHNSON

My generation grew up worrying about the bomb, the only weapon of mass destruction we ever heard of. As a fourth grader I watched those black-and-white movies about what to do in the event of a nuclear attack, and dutifully crawled under my desk, clutching my head. Near the Nevada Test Site, schoolchildren were given a booklet (above) by the U.S. Atomic Energy Commission downplaying the threat from our own weapons tests. The year was 1957.

My 31-year-old son never learned how to "duck and cover." He watched the collapse of the Soviet Union and, like most of us, pushed thoughts of terrible weapons far down the list of things to worry about.

On September 11, 2001, his world, my world, your world changed. The threat of chemical, biological, and nuclear weapons in the hands of renegade nations or groups of terrorists became part of our everyday lives. We've woken up to newspaper headlines about "dirty bombs" and anthrax; at our headquarters in downtown Washington, D.C., we've heard so many terrorist warnings that we've grown a little numb. An attack seems not just possible, but perhaps even inevitable.

Author Lew Simons, photographer Lynn Johnson, picture editor Bert Fox, and senior editor Don Belt began our "Weapons of Mass Destruction" story long before September 11. After that date previously open doors slammed shut, but they found ways to open new ones. Their article, which begins on page two, is the story of a dark and complex world we had lived in, but not recognized, until that September morning.

Bill Allen

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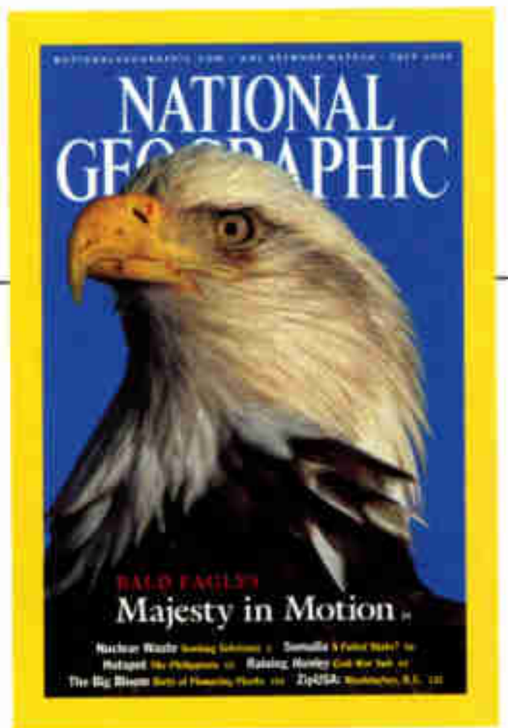
Forum



July 2002

The nuclear waste story prompted the most mail. Many readers thought we might have aided terrorists by revealing the location of waste storage sites. Everything in the article, including the map, was based on information available to the public. Other readers sent disposal suggestions. Why not send it to the sun? Technologically and fiscally impractical, experts say. The Mariana Trench? A containment nightmare.

Somalia

As a veteran of Operation Restore Hope in Somalia, I am glad to see NATIONAL GEOGRAPHIC address the continuing problems there. My platoon was the first U.S. Army force on the ground almost ten years ago, and in that time there has been no noticeable change. The warlords still control the country, the innocent are still starving, and dozens of human beings are being sacrificed in power struggles. It makes me wonder why we committed soldiers to go there and die if absolutely nothing has been accomplished. Maybe we should stay out of other countries' problems or, if we do become involved, be prepared to go the extra mile to finish the job.

SHANE A. SANDERS
Spokane, Washington

Author Andrew Cockburn mentioned that pirated videos of the film *Black Hawk Down* were being shown in Mogadishu. But he failed to mention that scores of locals repeatedly cheered when U.S. troops were shown being killed or wounded on screen. Any place that still celebrates such violent behavior is destined to repeat it—soon.

JOHN PLUNTZE
Ketchum, Idaho

Nuclear Waste

Antinuclear activists misrepresent what options are available for future electricity supply. Solar and wind can never provide a reliable supply of electricity. The sun doesn't shine at night or on cloudy days, and wind generators don't produce when the wind doesn't blow. Alternative technologies can be very valuable when they do work, but the best sources to produce reliable electricity for our future are nuclear energy and coal. Of the two, nuclear is far more environmentally benign, even with the need for spent fuel storage and eventual recycling.

MIKE MCCORMACK
Former Chair, House Subcommittee on Energy Research and Production
Medford, Oregon

Even if today's nuclear waste is not a threat after 10,000 years, the waste we create next year will remain a threat until 10,001

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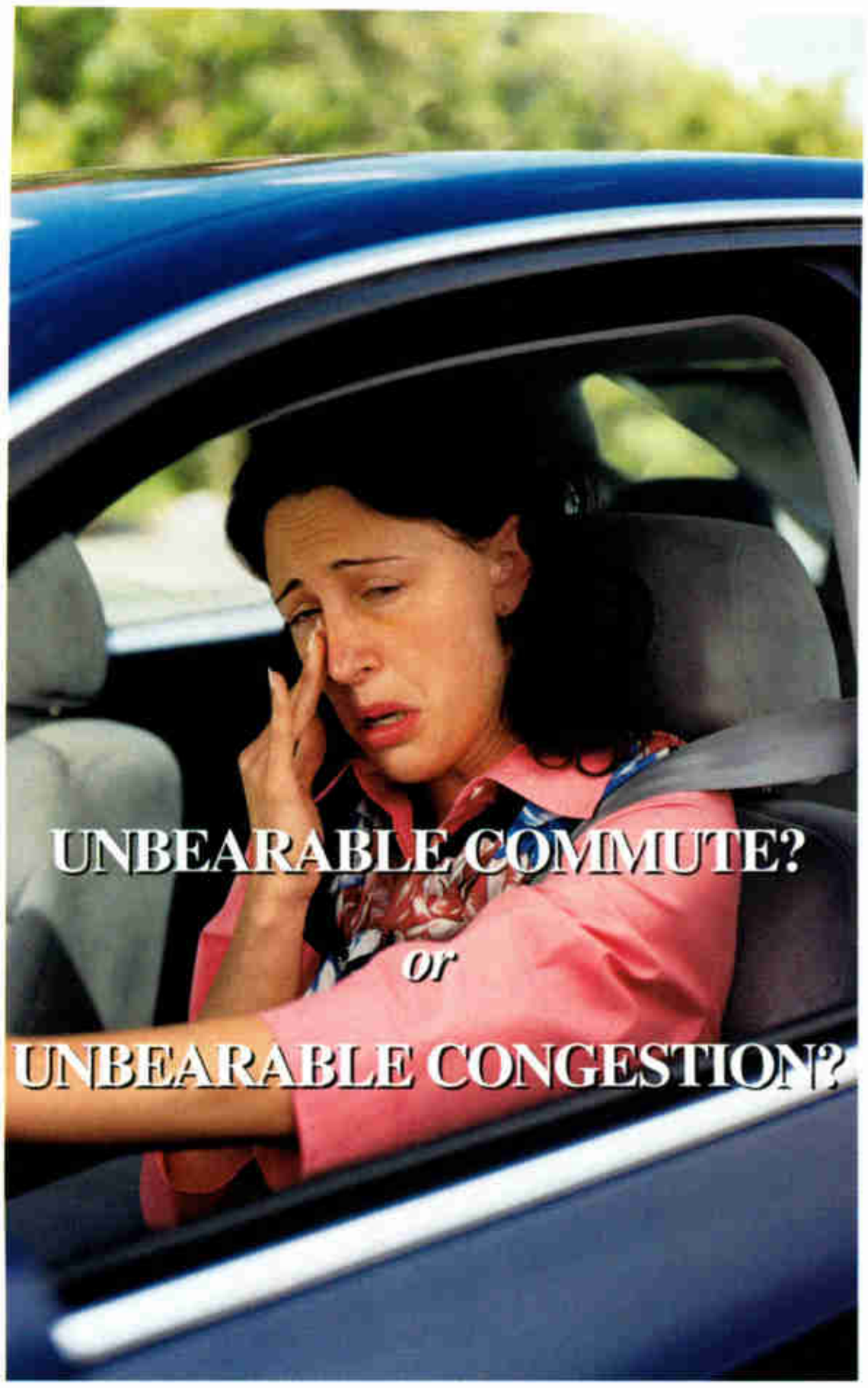

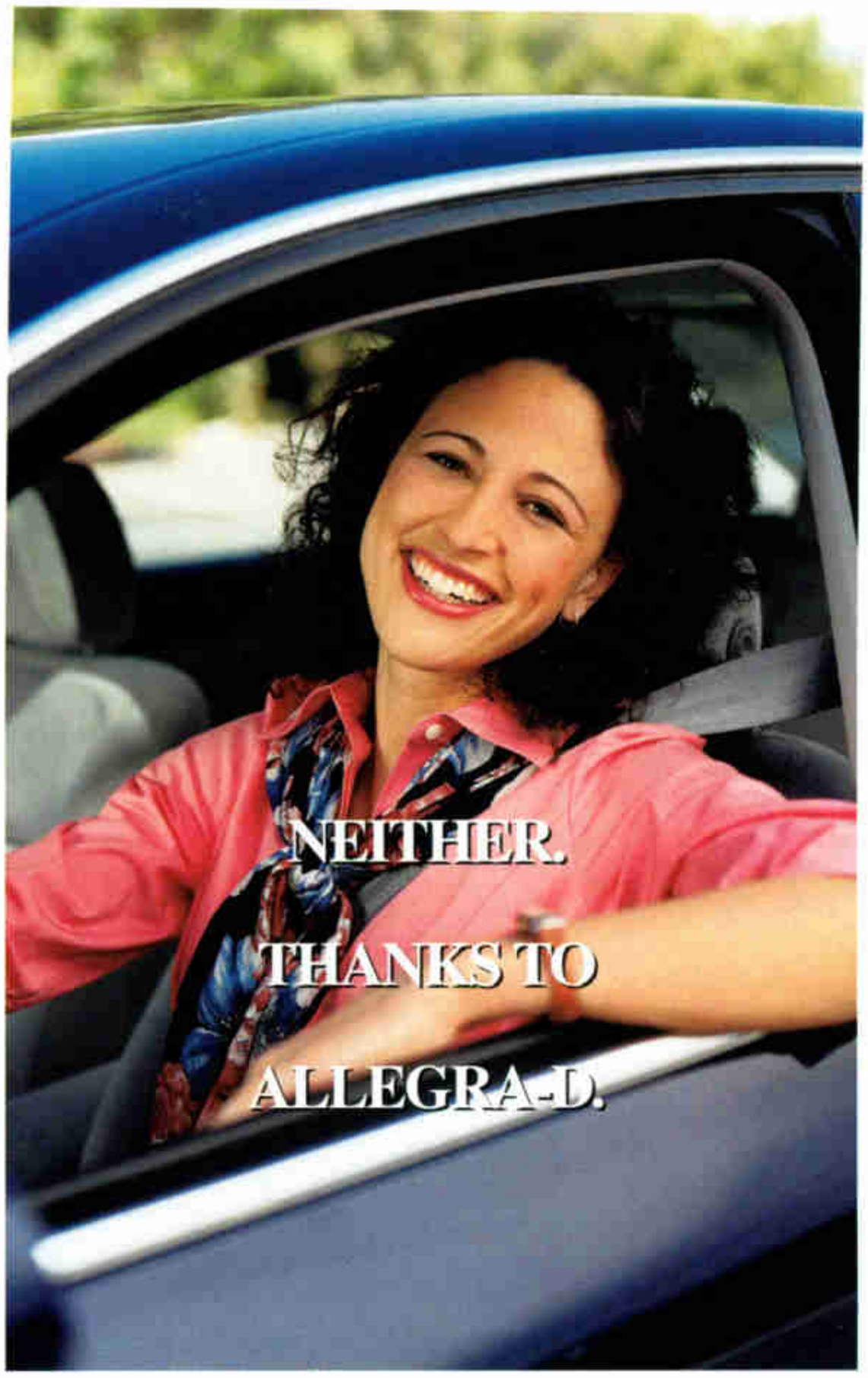

Side effects with Allegra-D were similar to Allegra alone and may include headache, insomnia, and nausea. Due to the decongestant (pseudoephedrine) component in Allegra-D, this product must not be used if you: are taking an MAO inhibitor (a medication for depression) or have stopped taking an MAO inhibitor within 14 days; retain urine; have narrow-angle glaucoma; have severe high blood pressure or severe heart disease. You should also tell your doctor if you have high blood pressure, diabetes, heart disease, glaucoma, thyroid disease, impaired kidney function, or symptoms of an enlarged prostate such as difficulty urinating. Allegra-D is for people twelve and older.

Multi-Symptom Relief:

The stuffy nose and sneezing from seasonal allergies can make any drive hard to take. Only Allegra-D has fexofenadine plus pseudoephedrine. So it provides real relief from allergies and congestion, without the drowsiness that can be caused by many other antihistamines.

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Real relief. For real living.

allegra-D®
fexofenadine HCl 60 mg/pseudoephedrine HCl 120 mg
Extended-Release Tablets

Please see additional important information on next page.

Brief Summary of
Prescribing Information as of November 2000

ALLEGRA-D®
(fexofenadine HCl 60 mg and pseudoephedrine HCl 120 mg)
Extended-Release Tablets

INDICATIONS AND USAGE
ALLEGRA-D is indicated for the relief of symptoms associated with seasonal allergic rhinitis in adults and children 12 years of age and older. Symptoms treated effectively include sneezing, rhinorrhea, itchy nose/palate/ and/or throat, itchy/watery/red eyes, and nasal congestion. ALLEGRA-D should be administered when both the antihistaminic properties of fexofenadine hydrochloride and the nasal decongestant properties of pseudoephedrine hydrochloride are desired (see CLINICAL PHARMACOLOGY).

CONTRAINDICATIONS
ALLEGRA-D is contraindicated in patients with known hypersensitivity to any of its ingredients.
Due to its pseudoephedrine component, ALLEGRA-D is contraindicated in patients with narrow-angle glaucoma or urinary retention, and in patients receiving monoamine oxidase (MAO) inhibitor therapy or within fourteen (14) days of stopping such treatment (see Drug Interactions section). It is also contraindicated in patients with severe hypertension, or severe coronary artery disease, and in those who have shown hypersensitivity or idiosyncrasy to its components, to adrenergic agents, or to other drugs of similar chemical structures. Manifestations of patient idiosyncrasy to adrenergic agents include: insomnia, dizziness, weakness, tremor, or arrhythmias.

WARNINGS
Sympathomimetic amines should be used judiciously and sparingly in patients with hypertension, diabetes mellitus, ischemic heart disease, increased intraocular pressure, hyperthyroidism, renal impairment, or prostatic hypertrophy (see CONTRAINDICATIONS). Sympathomimetic amines may produce central nervous system stimulation with convulsions or cardiovascular collapse with accompanying hypotension.

PRECAUTIONS
General
Due to its pseudoephedrine component, ALLEGRA-D should be used with caution in patients with hypertension, diabetes mellitus, ischemic heart disease, increased intraocular pressure, hyperthyroidism, renal impairment, or prostatic hypertrophy (see WARNINGS and CONTRAINDICATIONS). Patients with decreased renal function should be given a lower initial dose (one tablet per day) because they have reduced elimination of fexofenadine and pseudoephedrine (See CLINICAL PHARMACOLOGY and DOSAGE AND ADMINISTRATION).

Information for Patients
Patients taking ALLEGRA-D tablets should receive the following information: ALLEGRA-D tablets are prescribed for the relief of symptoms of seasonal allergic rhinitis. Patients should be instructed to take ALLEGRA-D tablets only as prescribed. **Do not exceed the recommended dose.** If nervousness, dizziness, or sleeplessness occur, discontinue use and consult the doctor. Patients should also be advised against the concurrent use of ALLEGRA-D tablets with over-the-counter antihistamines and decongestants.
The product should not be used by patients who are hypersensitive to it or to any of its ingredients. Due to its pseudoephedrine component, this product should not be used by patients with narrow-angle glaucoma, urinary retention, or by patients receiving a monoamine oxidase (MAO) inhibitor or within 14 days of stopping use of MAO inhibitor. It also should not be used by patients with severe hypertension or severe coronary artery disease.
Patients should be told that this product should be used in pregnancy or lactation only if the potential benefit justifies the potential risk to the fetus or nursing infant. Patients should be cautioned not to break or chew the tablet. Patients should be directed to swallow the tablet whole. Patients should be instructed not to take the tablet with food. Patients should also be instructed to store the medication in a tightly closed container in a cool, dry place, away from children.

Drug Interactions
Fexofenadine hydrochloride and pseudoephedrine hydrochloride do not influence the pharmacokinetics of each other when administered concomitantly.
Fexofenadine has been shown to exhibit minimal (ca. 5%) metabolism. However, co-administration of fexofenadine with ketoconazole and erythromycin led to increased plasma levels of fexofenadine. Fexofenadine had no effect on the pharmacokinetics of erythromycin and ketoconazole. In two separate studies, fexofenadine HCl 120 mg BID (twice the recommended dose) was co-administered with erythromycin 500 mg every 8 hours or ketoconazole 400 mg once daily under steady-state conditions to normal, healthy volunteers (n=24, each study). No differences in adverse events or QT_c interval were observed when subjects were administered fexofenadine HCl alone or in combination with erythromycin or ketoconazole. The findings of these studies are summarized in the following table:

Effects on Steady-State Fexofenadine Pharmacokinetics After 7 Days of Co-Administration with Fexofenadine Hydrochloride 120 mg Every 12 Hours (twice recommended dose) in Normal Volunteers (n=24)

Concomitant Drug	$C_{max\ SS}$ *(Peak plasma concentration)*	$AUC_{SS(0\text{-}12h)}$ *(Extent of systemic exposure)*
Erythromycin (500 mg every 8 hrs)	+82%	+109%
Ketoconazole (400 mg once daily)	+135%	+164%

The changes in plasma levels were within the range of plasma levels achieved in adequate and well-controlled clinical trials.
The mechanism of these interactions has been evaluated in *in vitro*, *in situ* and *in vivo* animal models. These studies indicate that ketoconazole or erythromycin co-administration enhances fexofenadine gastrointestinal absorption. In vivo animal studies also suggest that in addition to enhancing absorption, ketoconazole decreases fexofenadine gastrointestinal secretion, while erythromycin may also decrease biliary excretion.
ALLEGRA-D tablets (pseudoephedrine component) are contraindicated in patients taking monoamine oxidase inhibitors and for 14 days after stopping use of an MAO inhibitor. Concomitant use with antihypertensive drugs which interfere with sympathetic activity (eg, methyldopa, mecamylamine, and reserpine) may reduce their antihypertensive effects. Increased ectopic pacemaker activity can occur when pseudoephedrine is used concomitantly with digitalis.
Care should be taken in the administration of ALLEGRA-D concomitantly with other sympathomimetic amines because combined effects on the cardiovascular system may be harmful to the patient (see WARNINGS).

Carcinogenesis, Mutagenesis, Impairment of Fertility
There are no animal or *in vitro* studies on the combination product fexofenadine hydrochloride and pseudoephedrine hydrochloride to evaluate carcinogenesis, mutagenesis, or impairment of fertility.
The carcinogenic potential and reproductive toxicity of fexofenadine hydrochloride were assessed using terfenadine studies with adequate fexofenadine exposure (area-under-the plasma concentration versus time curve [AUC]). No evidence of carcinogenicity was observed when mice and rats were given daily oral doses up to 150 mg/kg of terfenadine for 18 and 24 months, respectively. In both species, 150 mg/kg of terfenadine produced AUC values of fexofenadine that were approximately 3 times the human AUC at the maximum recommended daily oral dose in adults.
Two-year feeding studies in rats and mice conducted under the auspices of the National Toxicology Program (NTP) demonstrated no evidence of carcinogenic potential with ephedrine sulfate, a structurally related drug with pharmacological properties similar to pseudoephedrine, at doses up to 10 and 27 mg/kg, respectively (approximately 1/3 and 1/2, respectively, the maximum recommended daily oral dose of pseudoephedrine hydrochloride in adults on a mg/m^2 basis).
In *in vitro* (Bacterial Reverse Mutation, CHO/HGPRT Forward Mutation, and Rat Lymphocyte Chromosomal Aberration assays) and *in vivo* (Mouse Bone Marrow Micronucleus assay) tests, fexofenadine hydrochloride revealed no evidence of mutagenicity.
Reproduction and fertility studies with terfenadine in rats produced no effect on male or female fertility at oral doses up to 300 mg/kg/day. However, reduced implants and post implantation losses were reported at 300 mg/kg. A reduction in implants was also observed at an oral dose of 150 mg/kg/day. Oral doses of 150 and 300 mg/kg of terfenadine produced AUC values of fexofenadine that were approximately 3 and 4 times, respectively, the human AUC at the maximum recommended daily oral dose in adults.

Pregnancy
Teratogenic Effects: Category C. Terfenadine alone was not teratogenic in rats and rabbits at oral doses up to 300 mg/kg; 300 mg/kg of terfenadine produced fexofenadine AUC values that were approximately 4 and 30 times, respectively, the human AUC at the maximum recommended daily oral dose in adults.
The combination of terfenadine and pseudoephedrine hydrochloride in a ratio of 1:2 by weight was studied in rats and rabbits. In rats, an oral combination dose of 150/300 mg/kg produced reduced fetal weight and delayed ossification with a finding of wavy ribs. The dose of 150 mg/kg

of terfenadine in rats produced an AUC value of fexofenadine that was approximately 3 times the human AUC at the maximum recommended daily oral dose in adults. The dose of 300 mg/kg of pseudoephedrine hydrochloride in rats was approximately 10 times the maximum recommended daily oral dose in adults on a mg/m² basis. In rabbits, an oral combination dose of 100/200 mg/kg produced decreased fetal weight. By extrapolation, the AUC of fexofenadine for 100 mg/kg orally of terfenadine was approximately 10 times the human AUC at the maximum recommended daily oral dose in adults. The dose of 200 mg/kg of pseudoephedrine hydrochloride was approximately 15 times the maximum recommended daily oral dose in adults on a mg/m² basis.

There are no adequate and well-controlled studies in pregnant women. ALLEGRA-D should be used during pregnancy only if the potential benefit justifies the potential risk to the fetus.

Nonteratogenic Effects. Dose-related decreases in pup weight gain and survival were observed in rats exposed to an oral dose of 150 mg/kg of terfenadine; this dose produced an AUC of fexofenadine that was approximately 3 times the human AUC at the maximum recommended daily oral dose in adults.

Nursing Mothers

It is not known if fexofenadine is excreted in human milk. Because many drugs are excreted in human milk, caution should be used when fexofenadine hydrochloride is administered to a nursing woman. Pseudoephedrine hydrochloride administered alone distributes into breast milk of lactating human females. Pseudoephedrine concentrations in milk are consistently higher than those in plasma. The total amount of drug in milk as judged by AUC is 2 to 3 times greater than the plasma AUC. The fraction of a pseudoephedrine dose excreted in milk is estimated to be 0.4% to 0.7%. A decision should be made whether to discontinue nursing or to discontinue the drug, taking into account the importance of the drug to the mother. Caution should be exercised when ALLEGRA-D is administered to nursing women.

Pediatric Use

Safety and effectiveness of ALLEGRA-D in pediatric patients under the age of 12 years have not been established.

Geriatric Use

Clinical studies of ALLEGRA-D did not include sufficient numbers of patients aged 65 and older to determine whether they respond differently from younger patients. Other reported clinical experience has not identified differences in responses between the elderly and younger patients, although the elderly are more likely to have adverse reactions to sympathomimetic amines. In general, dose selection for an elderly patient should be cautious, usually starting at the low end of the dosing range, reflecting the greater frequency of decreased hepatic, renal, or cardiac function, and of concomitant disease or other drug therapy.

The pseudoephedrine component of ALLEGRA-D is known to be substantially excreted by the kidney, and the risk of toxic reactions to this drug may be greater in patients with impaired renal function. Because elderly patients are more likely to have decreased renal function, care should be taken in dose selection, and it may be useful to monitor renal function.

ADVERSE REACTIONS

ALLEGRA-D

In one clinical trial (n=651) in which 215 patients with seasonal allergic rhinitis received the 60 mg fexofenadine hydrochloride/120 mg pseudoephedrine hydrochloride combination tablet twice daily for up to 2 weeks, adverse events were similar to those reported either in patients receiving fexofenadine hydrochloride 60 mg alone (n=218 patients) or in patients receiving pseudoephedrine hydrochloride 120 mg alone (n=218). A placebo group was not included in this study.

The percent of patients who withdrew prematurely because of adverse events was 3.7% for the fexofenadine hydrochloride/pseudoephedrine hydrochloride combination group, 0.5% for the fexofenadine hydrochloride group, and 4.1% for the pseudoephedrine hydrochloride group. All adverse events that were reported by greater than 1% of patients who received the recommended daily dose of the fexofenadine hydrochloride/pseudoephedrine hydrochloride combination are listed in the following table.

Adverse Experiences Reported in One Active-Controlled Seasonal Allergic Rhinitis Clinical Trial at Rates of Greater than 1%

Adverse Experience	60 mg Fexofenadine Hydrochloride/120 mg Pseudoephedrine Hydrochloride Combination Tablet Twice Daily (n=215)	Fexofenadine Hydrochloride 60 mg Twice Daily (n=218)	Pseudoephedrine Hydrochloride 120 mg Twice Daily (n=218)
Headache	13.0%	11.5%	17.4%
Insomnia	12.6%	3.2%	13.3%
Nausea	7.4%	0.5%	5.0%
Dry Mouth	2.8%	0.5%	5.5%
Dyspepsia	2.8%	0.5%	0.9%
Throat Irritation	2.3%	1.8%	0.5%
Dizziness	1.9%	0.0%	3.2%
Agitation	1.9%	0.0%	1.4%
Back Pain	1.9%	0.5%	0.5%
Palpitation	1.9%	0.0%	0.9%
Nervousness	1.4%	0.5%	1.8%
Anxiety	1.4%	0.0%	1.4%
Upper Respiratory Infection	1.4%	0.9%	0.9%
Abdominal Pain	1.4%	0.5%	0.5%

Many of the adverse events occurring in the fexofenadine hydrochloride/pseudoephedrine hydrochloride combination group were adverse events also reported predominately in the pseudoephedrine hydrochloride group, such as insomnia, headache, nausea, dry mouth, dizziness, agitation, nervousness, anxiety, and palpitation.

Fexofenadine Hydrochloride

In placebo-controlled clinical trials, which included 2461 patients receiving fexofenadine hydrochloride at doses of 20 mg to 240 mg twice daily, adverse events were similar in fexofenadine hydrochloride and placebo-treated patients. The incidence of adverse events, including drowsiness, was not dose related and was similar across subgroups defined by age, gender, and race. The percent of patients who withdrew prematurely because of adverse events was 2.2% with fexofenadine hydrochloride vs 3.3% with placebo.

Events that have been reported during controlled clinical trials involving seasonal allergic rhinitis and chronic idiopathic urticaria patients with incidences less than 1% and similar to placebo and have been rarely reported during postmarketing surveillance include: insomnia, nervousness, and sleep disorders or paroniria. In rare cases, rash, urticaria, pruritus and hypersensitivity reactions with manifestations such as angioedema, chest tightness, dyspnea, flushing and systemic anaphylaxis have been reported.

Pseudoephedrine Hydrochloride

Pseudoephedrine hydrochloride may cause mild CNS stimulation in hypersensitive patients. Nervousness, excitability, restlessness, dizziness, weakness, or insomnia may occur. Headache, drowsiness, tachycardia, palpitation, pressor activity, and cardiac arrhythmias have been reported. Sympathomimetic drugs have also been associated with other untoward effects such as fear, anxiety, tenseness, tremor, hallucinations, seizures, pallor, respiratory difficulty, dysuria, and cardiovascular collapse.

Prescribing Information as of November 2000

Aventis Pharmaceuticals Inc.
Kansas City, MO 64137 USA

US Patents 4,254,129; 5,375,693; 5,578,610.

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alldb1100Aj

ALD-JA-2070-1

Aventis

Aventis Pharmaceuticals
Bridgewater, NJ 08807

Bald Eagles

While taking the bald eagle off the endangered species list may be a sign that these birds have recovered from the onslaught of the mid-1900s, it is in no way a sign that they will be protected from extinction in the future—whether it be from habitat destruction, environmental disasters, a disruption of the food chain, or a return to hunting. The eagle's fragile and delicate ecosystems need to be protected. Legislation by governments is helpful. Yet it takes independent effort by all of us to prevent further insults to the environment and irreversible damage to the eagles' territory. Once this is achieved, the birds may have the chance to breed, flourish, and soar like they did hundreds of years ago. Otherwise we will be forced to appreciate their beauty in magazine pictures and zoo cages.

BRETT I. GINGOLD
Rochester, New York

Your story on eagles begins with a reference to wilderness. In the late 1980s a mated pair spent the winter in Lincoln Park in Blaine, Washington, within a block of a busy thoroughfare. On both of my trips to Alaska in my boat in 1980 and 1993, the eagles were not to be seen on the wild stretches of the voyage. But I saw them in Juneau and around most of the towns of southeast Alaska. All this brouhaha about eagles loving only wilderness is what Henry Ford used to call bunk.

FRANCIS L. POST
Bellingham, Washington

NORBERT ROSING

The cry of an eagle is puny and pitiful, almost a squeak, and quite unfitting for what many call "that noble bird." Noble bird indeed! Eagles often steal fish by intimidating those wonderful, admirable fish catchers, the ospreys. I agree with Ben Franklin that the American wild turkey should have been our national emblem. It's equally majestic in its own way and darn good eating.

HUGH WARE
Manchester, Massachusetts

years from now. We do not have an infinite number of Yucca Mountains to fill with toxic trash.

MONTSERRAT ARCHBALD
Whately, Massachusetts

The article was well researched and well written but still exhibited an antinuclear bias. An example is the subtitle: "The Lethal Legacy of America's Nuclear Waste." Things that kill people are lethal. Among the things that kill people are table salt, slippery bathtubs, water, and little red wagons, but I am unaware of anyone ever being killed by radioactive waste. Many thousands of shipments of radioactive materials have been made in the U.S. alone, and there has never been a breach of containment nor any reason to believe anyone has been harmed by it. Compare that with safety records for the transportation of any other hazardous material, such as gasoline, liquid ammonia, or nitric acid.

J. MALVYN McKIBBEN
Aiken, South Carolina

Having worked for over 18 years at the Callaway nuclear plant in Missouri, I thought the article was thought provoking. I believe that one explanation for this mess that we have gotten ourselves into was missing. We consume and waste far too much energy. But knowing the unquenchable hunger we have for energy, I feel my job is very secure here.

ROD DERLETH
Jefferson City, Missouri

I was disappointed the author made no mention of the Western Shoshone people. Yucca Mountain falls within traditional lands of these people. It is known as Serpent Swimming West. Under the Treaty of Peace and Friendship signed at Ruby Valley in 1863, Yucca and other surrounding land belongs to the Western Shoshone, and therefore the U.S. government has no right to dump its nuclear waste there without permission. The Western Shoshone National Council, which is the traditional government, has not given its permission. These sacred lands are still used and occupied by Western Shoshone people, whose health will be at risk if 77,000 tons of waste is buried in their land.

JENNIFER STERLING
Winnipeg, Manitoba

The photograph of Yucca Mountain, Nevada, reminded me of many of the tombs built by

WRITE TO FORUM

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If this bird could talk,
He'd Tell you How a
dish Liquid saved his Life.
If this bird could talk,
he'd Tell you How
He ALMOST died from
an oil Spill
AND How DAWN WAS there to HELP CLEAN Him UP.
If THIS bird could talk, he'd tell you How wildlife experts
CHOOSE DAWN
because it cuts GREASE while being gentle on SKIN.
If this bird could talk,
He'd Tell You How Happy he is to be Alive today.

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DAWN

SAVING wildlife FOR OVER 20 YEARS

Egyptians. However, Egyptians buried their kings in tombs because they thought they were immortal. The U.S. buries its nuclear waste because the waste *is* immortal.

MELISSA KRETSCHMER
Brooklyn, New York

The Big Bloom

We were enormously disappointed that the *Florissantia* fossil's original location was not identified. The fossil was found in Republic, Washington, in the Klondike Mountain formation, and has been on display at the Stonerose Interpretive Center for the past 11 years.

LISA BARKSDALE
Curator, Stonerose Interpretive Center
Republic, Washington

Hotspot: The Philippines

In the Philippines many reminisce about the days when we had clean seas and rivers, clean air to breathe, and many more unique species of animals and plants. My grandfather and his circle of barbershop friends cannot help comparing the environment they experience now in their daily walks with that of 20 years ago, when even canals smelled good. There is a need for awareness and concern in my country. Calling attention to its fragile biosphere is an effective first step in preserving biodiversity. Given some more time to analyze these things, and the strong efforts of conservationists, my people may yet change their attitude of waste and fatalism—"*Bahala na*" ("I don't care what happens in the future, as long as I survive now").

IVY LUBIANO
Cebu, Philippines

FROM OUR ONLINE FORUM
nationalgeographic.com/ngm/0207

The *Hunley*

The article's concluding paragraph really upset me. General Beauregard was an enemy of the U.S.; his orders ("pay a proper tribute to the gallantry and patriotism" of the *Hunley*'s crew) lay no onus upon us. The causes of the Civil War were complex and many, but they were bound tightly with a vile and repulsive practice whose legacy still afflicts us terribly. At least part of what the South was defending was the right to cruelly subjugate one's fellow man and to suppress entirely his rights. The enormity of the evil

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SUBURBAN LIKE A ROCK

of that practice throws over whatever nobler aims or ideals the Confederacy embraced. The blow struck by the *Hunley* was a blow against the story of the expanding awareness of human rights and possibilities that is the central narrative of America. Like all dead, the men of the *Hunley* deserve respect and compassion, not least because in supporting the cause they did, those men were so badly misled. But bravery alone does not beget heroes, nor does death in arms alone signify patriots. The men of the *Hunley* are neither.

SANJAY KRISHNASWAMY
Berkeley, California

The railroad map does not show the correct route used to transport the submarine from Mobile to Charleston. A more direct line from Mobile through central Alabama to Atlanta was used. As early as May 1862, Corinth, Mississippi (a railroad hub in the state's northeastern corner), was occupied by Federal forces, as was most of the Memphis and Charleston line across northern Alabama in the following weeks.

BILL BUTLER
Lincoln, Missouri

The artifact shown at the bottom of page 97, referred to as a "beard comb," appears to be a louse comb used for removing lice and their eggs from hair (that's why it has such fine teeth).

KARL FRITCH
Bay Shore, New York

The device is actually called a mustache comb. But as always, we are grateful for the nit-picking of our attentive readers.

Geographica

The illustration in the item "Maya Paint: Made to Last" is not of the Maya murals at Bonampak, but of the Maya-style paintings at Cacaxtla in Mexico's central highlands. Stylistic similarities suggest, however, that Maya artists may have been employed, far from their homeland.

NORMAN HAMMOND
Professor of Archaeology, Boston University
Boston, Massachusetts

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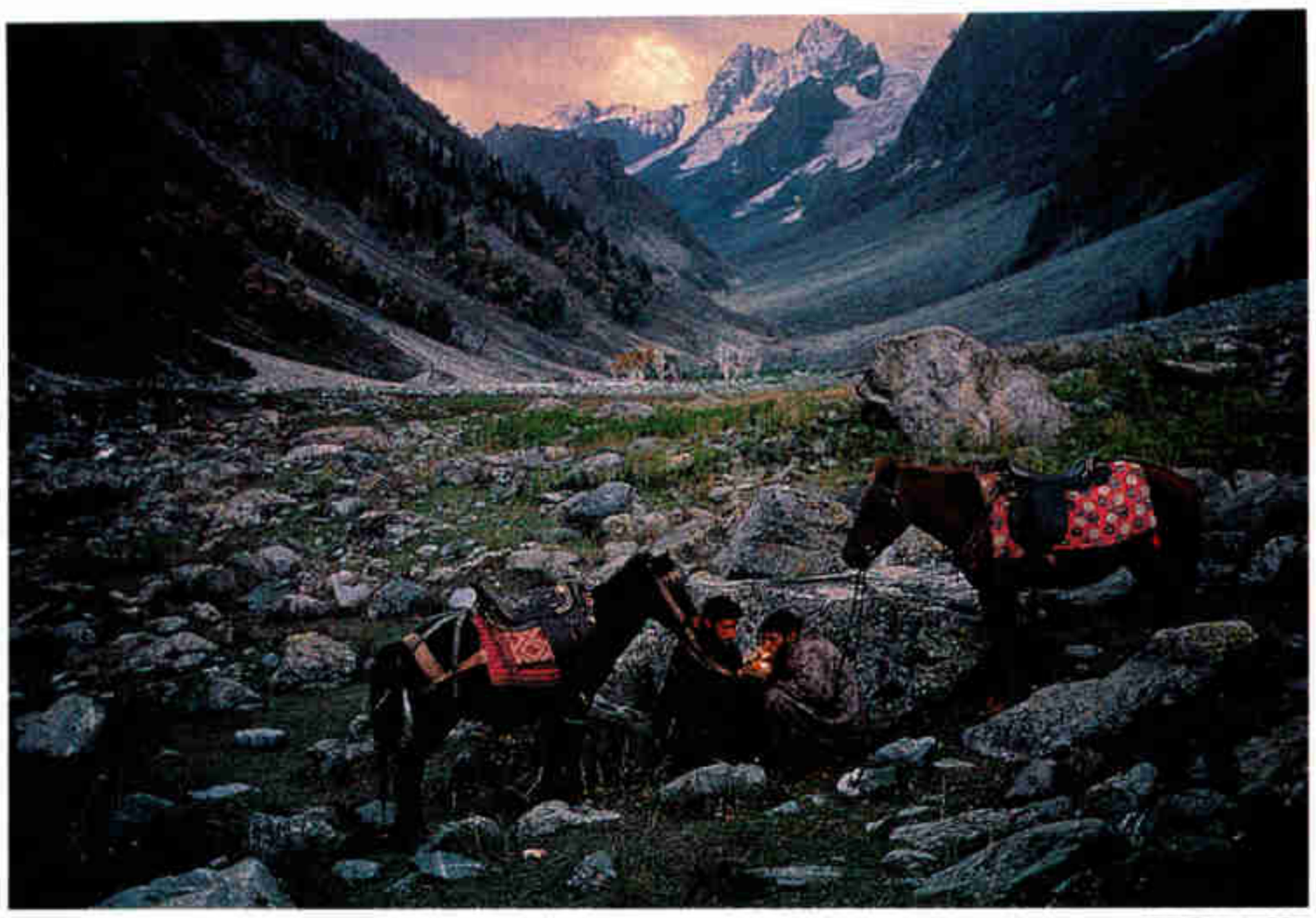
WORLD AFFAIRS

Apocalypse Soon?

Threat of nuclear war grips India, Pakistan



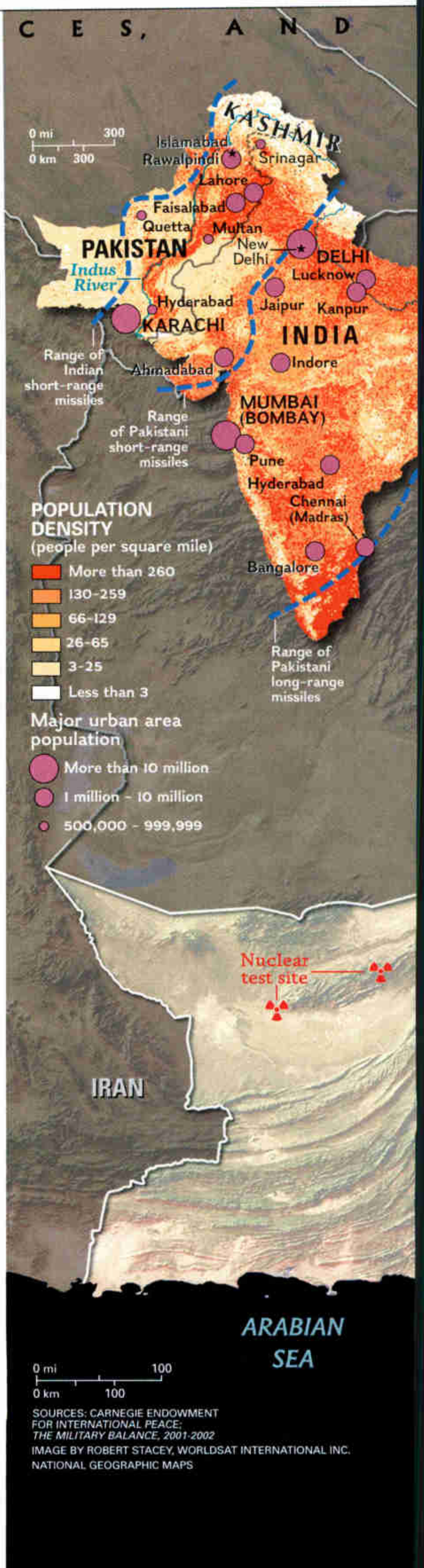
STEVE McCURRY

The most dangerous place in the world. That's what many diplomats and military specialists see when they consider the volatile politics and formidable geography of the Indian subcontinent. And this is the time of year when hostilities between Pakistan and India have escalated historically.

The two neighbors, adversaries from the moment they were created in 1947 with the partition of British India, have amassed thousands of troops in the disputed Himalayan region of Kashmir, whose lofty valleys (above) have long served as invasion routes between warring neighbors. The desire to protect its northern flank—and to maintain its pluralistic identity—drives India's refusal to part with its only Muslim-majority state. Meanwhile Pakistan, predominantly Muslim, insists that Kashmiris should have the right to decide themselves whether they want to be part of Pakistan or India.

The two nations have already gone to war three times (1947-48, 1965, and 1971, not to mention the 1999 Kargil conflict), and a seemingly permanent, heavily fortified line of control now divides the disputed region. Frequent artillery exchanges across this line, terrorist attacks inside India, and fiery rhetoric by leaders have kept both nations on a war alert. Tensions eased during the summer, following diplomatic interventions from the United States, Russia, and other countries, but the dispute still festers.

Should a ground war break out, terrain and weather patterns could play major roles in the timing and duration of hostilities, and in determining the eventual death toll. The trigger for all-out war cited by many military analysts would be



APHICA

CREATURES OF OUR UNIVERSE

BOUNDARY DISPUTES

After the 1947 partition, the ruler of the princely state of Jammu and Kashmir acceded to India.

The line of control generally marks the cease-fire line established in 1949 after the first India-Pakistan war.

The Indian army has occupied the Siachen Glacier region since 1984, thwarting Pakistan's claim to the area.

A border war erupted in 1962 after India discovered that China had built a road in the disputed Aksai Chin region.

TAJIKISTAN

Ganges River

AFGHANISTAN

KOLKATA (CALCUTTA)

K NORTHERN A Gilgit S AREAS H INDIAN MILITARY LINE M I R

Siachen Glacier

AKSAI CHIN

Boundary claimed by India

Boundary undefined

Boundary claimed by India

Kargil

LINE OF CONTROL

Muzaffarabad

AZAD KASHMIR

Srinagar

Vale of Kashmir

JAMMU AND KASHMIR

CHINA

Kabul

Islamabad

Jammu

Boundary claimed by China

MISSILE RANGES

Both countries have tested ballistic missiles that can reach each other's major cities within 5 minutes; neither is capable of recalling missiles—or striking down the enemy's. The most likely delivery system, however, would be fighter-bomber aircraft, according to analysts.

Muslim 97%
Other 3%

144.6 million

PAKISTAN

$282 billion

620,000

35-50?

POPULATION 1.03 billion
One symbol equals 10 million people

Hindu 81.3%
Muslim 12%
Sikh 1.9%
Christian 2.3%
Other 2.5%

NEPAL

New Delhi

ECONOMY $2.2 trillion
(GDP: purchasing power parity)
One symbol equals 100 billion U.S. dollars

Nuclear test site

TROOPS 1.26 million
One symbol equals 100,000 troops

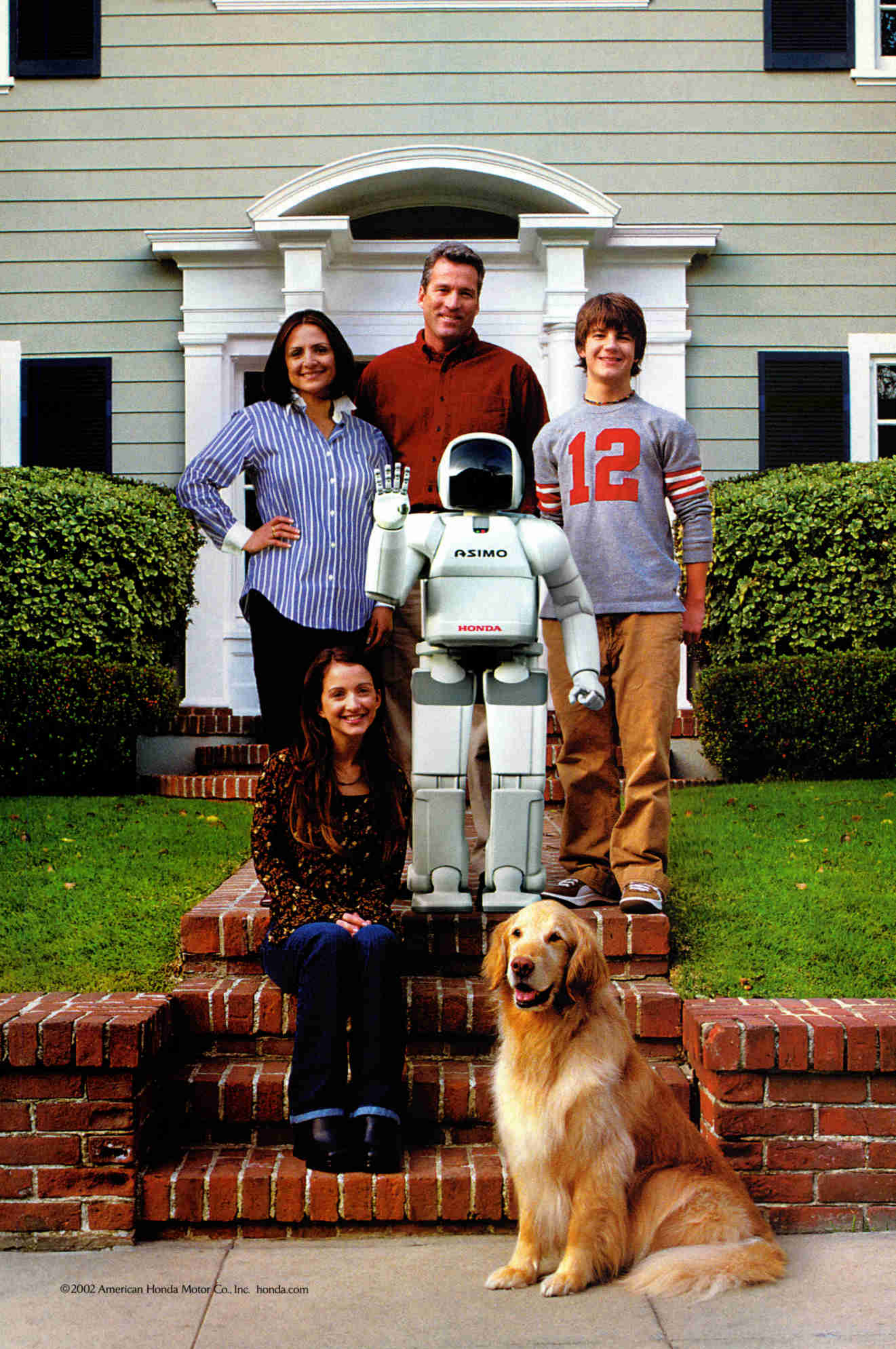
INDIA

NUCLEAR WEAPONS 35-50?
One symbol equals 1 weapon

Karachi

HOW MANY BOMBS?

With only a few people in each country knowing the size of the arsenal, outside analysts can only guess at the number of nuclear weapons. Estimates put the total for each side at between 35 and 50. Both may have more, especially India, which reportedly has accumulated enough weapons-grade material to make 100 to 150 nuclear bombs. Each is believed to yield 20 kilotons of explosive power, comparable to the bomb dropped on Hiroshima in 1945.



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The future of this exciting technology is even more promising. ASIMO has the potential to respond to simple voice commands, recognize faces, carry loads and even push wheeled objects. This means that, one day, ASIMO could be quite useful in some very important tasks. Like assisting the elderly, and even helping with household chores. In essence, ASIMO might serve as another set of eyes, ears and legs for all kinds of people in need.

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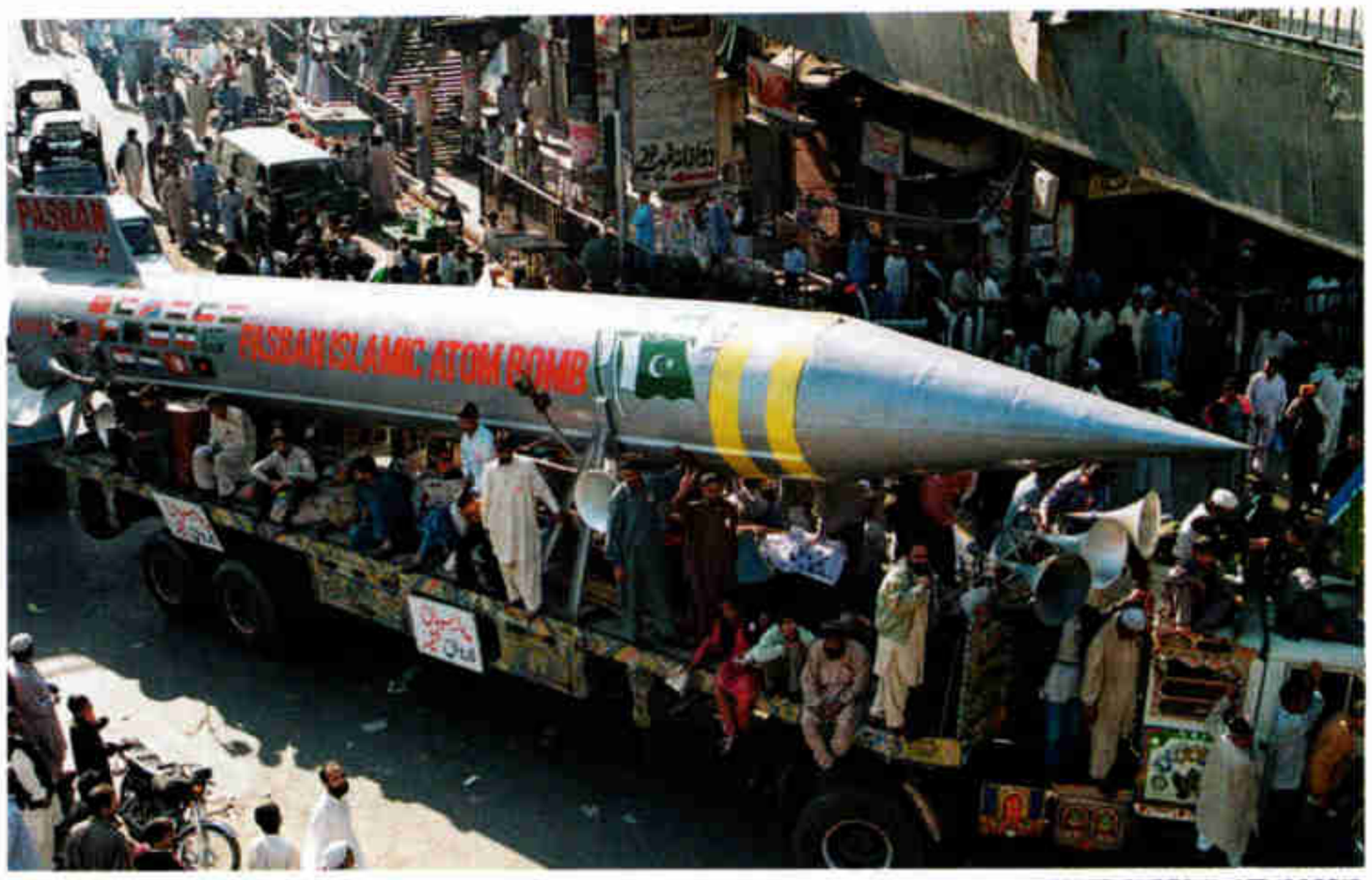
RAVEENDRAN, AFP/CORBIS

Nationalism incites partisans in the crowded cities of India and Pakistan. In the Indian capital of New Delhi, front-line veterans from Kashmir march en parade (left), and a protester (bottom) urges death to enemy leaders. Pakistanis in Karachi parade a mock nuke (below) with a defiant threat.

Indian troops chasing terrorists across the border. The window for a major ground offensive is limited because of climatic extremes. Heavy rains of the monsoon season (July through September) render the ground nearly impassable for advancing troops. Scorching temperatures preceding the monsoon and winter snows blocking mountain passes also disrupt military operations.

India dwarfs Pakistan in size, military might, and resources for a sustained conflict, but the threat of nuclear attack changes the equation. Pakistan has vowed to use all available means, which would include nuclear bombs, if its survival is threatened. India has pledged a no first-use policy.



AAMIR QURESHI, AFP/CORBIS

JOHN MacDOUGALL, AFP/CORBIS

Worst-case war simulations predict there could be 9 million to 30 million deaths.

Predicting exactly how a war would unfold between India and Pakistan is difficult in part because of uncertainty about the size and accuracy of their arsenals. According to the Carnegie Endowment for International Peace, each side may have 35 to 50 nuclear weapons, deliverable by plane or missile.

Once a nuclear-tipped missile is launched, no one has the means to recall it. Warning time for most targets will be less than five minutes. The darkest scenarios suggest that both countries would aim strikes at major cities. A blast and the following firestorm and rain of radioactive fallout could kill almost a million people in India's commercial hub of Mumbai (Bombay), warns one study. The high seasonal humidity in many of the region's cities would act to trap fallout and intensify its effects. Crop fields, the mainstay of India's and Pakistan's local economies, could be poisoned for at least a generation.

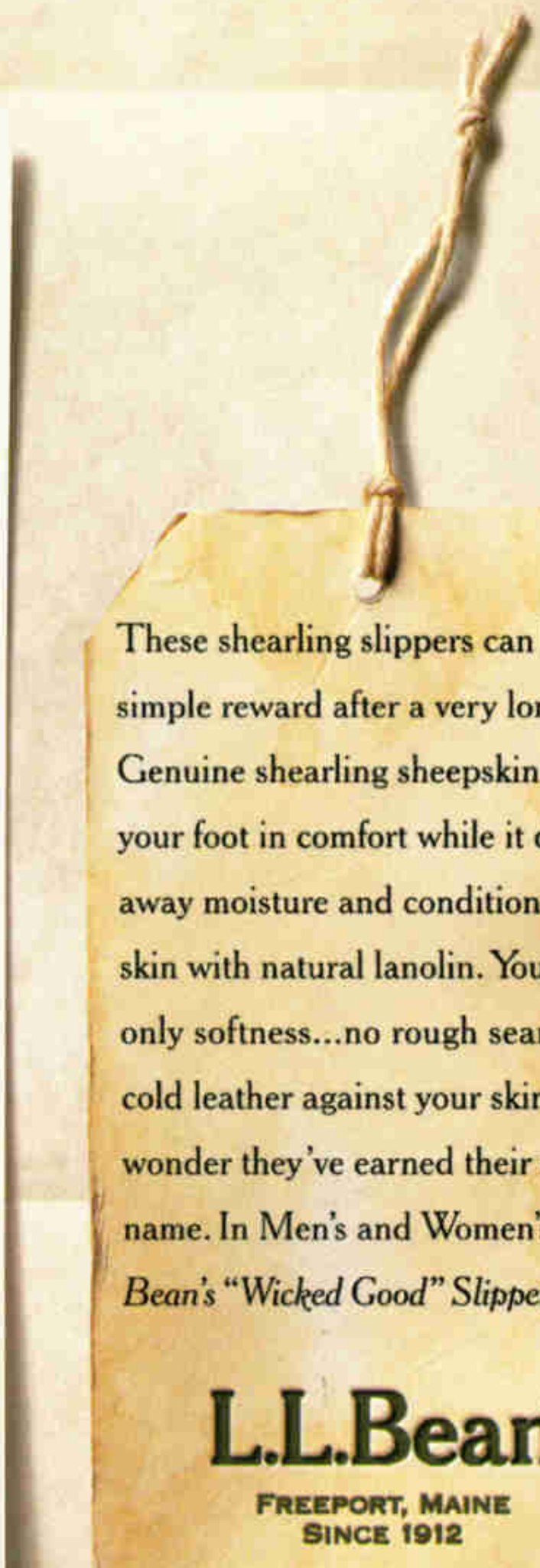
Any solution to the Kashmir dispute will likely entail more autonomy for the besieged inhabitants, but for now the region smolders, a fuse that could spark the planet's first war between nuclear-armed adversaries.

—Tom O'Neill

MORE ON OUR WEBSITE

Find links and resources selected by our Research Division at **nationalgeographic.com/ngm/resources/0211**.

In Maine, there's a term for comfort like this: "Wicked Good."



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BIODIVERSITY

A Whole New Kind of Insect

How I met the "gladiator"

Most people wouldn't get excited by an inch-long insect crawling on a rock. But the animal I saw near my campsite on Namibia's forbidding Brandberg mountain wasn't just any insect, and this wasn't just any camping trip. I was part of a two-week expedition to find living specimens of the "gladiator" (right, and life size, below), a small but aggressive animal that team leader Oliver Zompro of the Max Planck Institute in Plön, Germany, had recently realized didn't fit into any known order of insects. The new order, called Mantophasmatodea, is the first new insect order discovered since 1915.

A new order may not sound like a big deal. But imagine discovering elephants or turtles for the first time. Both represent orders in the classification of life.

Zompro had first seen gladiators embedded in 40-to-50-million-year-old Baltic amber, but he hadn't realized they might still be around until he found a few recently collected African specimens in several European museums. Our Namibian expedition was quickly organized to locate these living fossils.

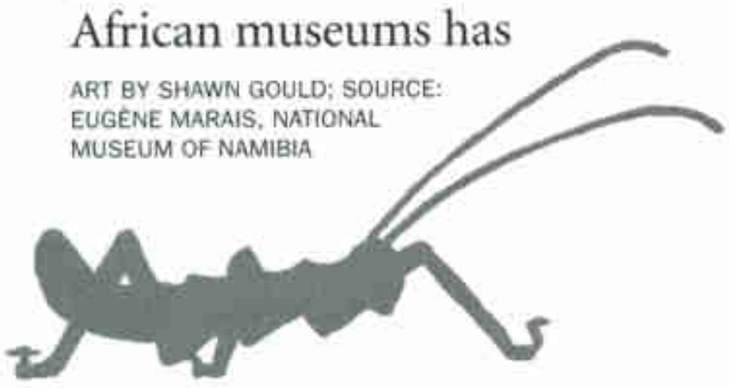
To our astonishment, gladiators were easy to find—once we knew where to look (humid rock crevices). So how did they elude scientists for so long? It might be their appearance—they look like immature mantises or walking sticks. In fact, a screening of insect collections in southern African museums has already turned up more new species of the new order.

Almost everything about their habits remains a mystery. We've learned that males attract mates by drumming on plant stems with their abdomens, and females lay eggs encased in protective foam deep in the soil.

The next step: Figuring out where else they live and defining their relationship with other insects (their anatomy and DNA suggest affinities with ice-crawlers, insects that forage at high elevations, often in ice and snow). No matter where gladiators end up on the tree of life, their discovery reminds me how little scientists know about the natural world.

—Piotr Naskrecki
CONSERVATION INTERNATIONAL

ART BY SHAWN GOULD; SOURCE: EUGÈNE MARAIS, NATIONAL MUSEUM OF NAMIBIA



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ZOOLOGY

Caught in the Act

A picture worth a thousand words to science: A fish is killed by a green anaconda in a stream in central Brazil—an event few have witnessed. Adult female anacondas can ambush birds, rodents, and caimans, but even agile young anacondas aren't quick enough to capture fish. This fish had been injured by another fish before the snake's fatal squeeze. Even so, the photo was an eye-opener for Venezuelan researcher Jesús Rivas. "In ten years I have never seen an anaconda constricting a fish." —*John L. Eliot*

LUCIANO CANDISANI

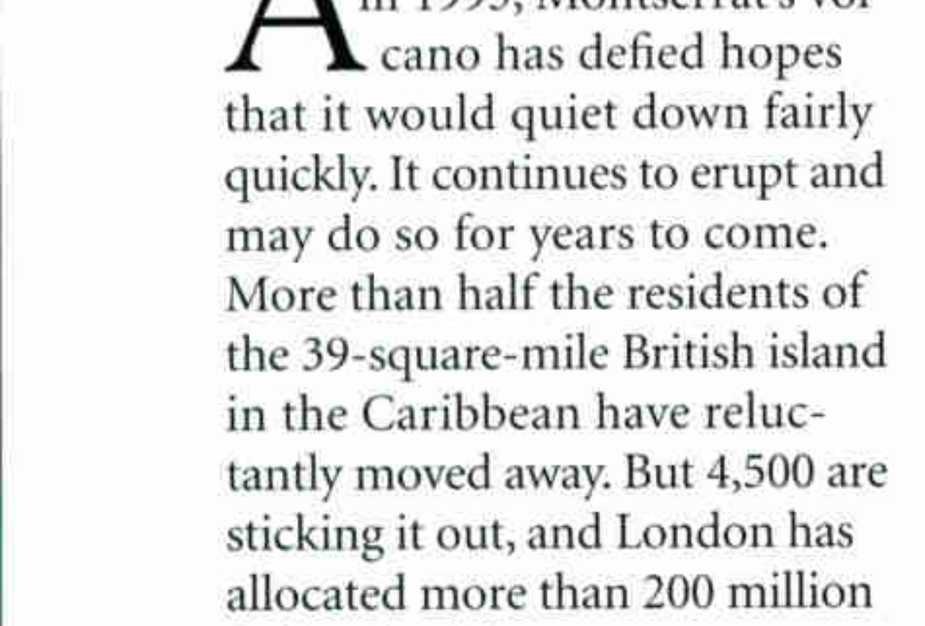
THE CARIBBEAN

Still Smokin'

Living with a hot volcano

After awakening with a bang in 1995, Montserrat's volcano has defied hopes that it would quiet down fairly quickly. It continues to erupt and may do so for years to come. More than half the residents of the 39-square-mile British island in the Caribbean have reluctantly moved away. But 4,500 are sticking it out, and London has allocated more than 200 million dollars in aid.

Since the volcano's first blasts ("Montserrat: Under the Volcano," GEOGRAPHIC, July 1997),



DONNA AND STEVE O'MEARA, VOLCANO WATCH INTERNATIONAL (BOTH)

holdouts have had to learn about the possible dangers to protect themselves. "When you hear a five-year-old talking about a pyroclastic flow, you *know* we've all become students," says Carol Osborne, owner of the Vue Pointe Hotel, referring to the clouds of ash, rock, and gas that boil down the sides of the cone with little warning. Young and old recently gathered at a lookout (left) to get a better view of the source: the fiery dome of lava (above) that builds, collapses, and builds again in a now-familiar cycle.

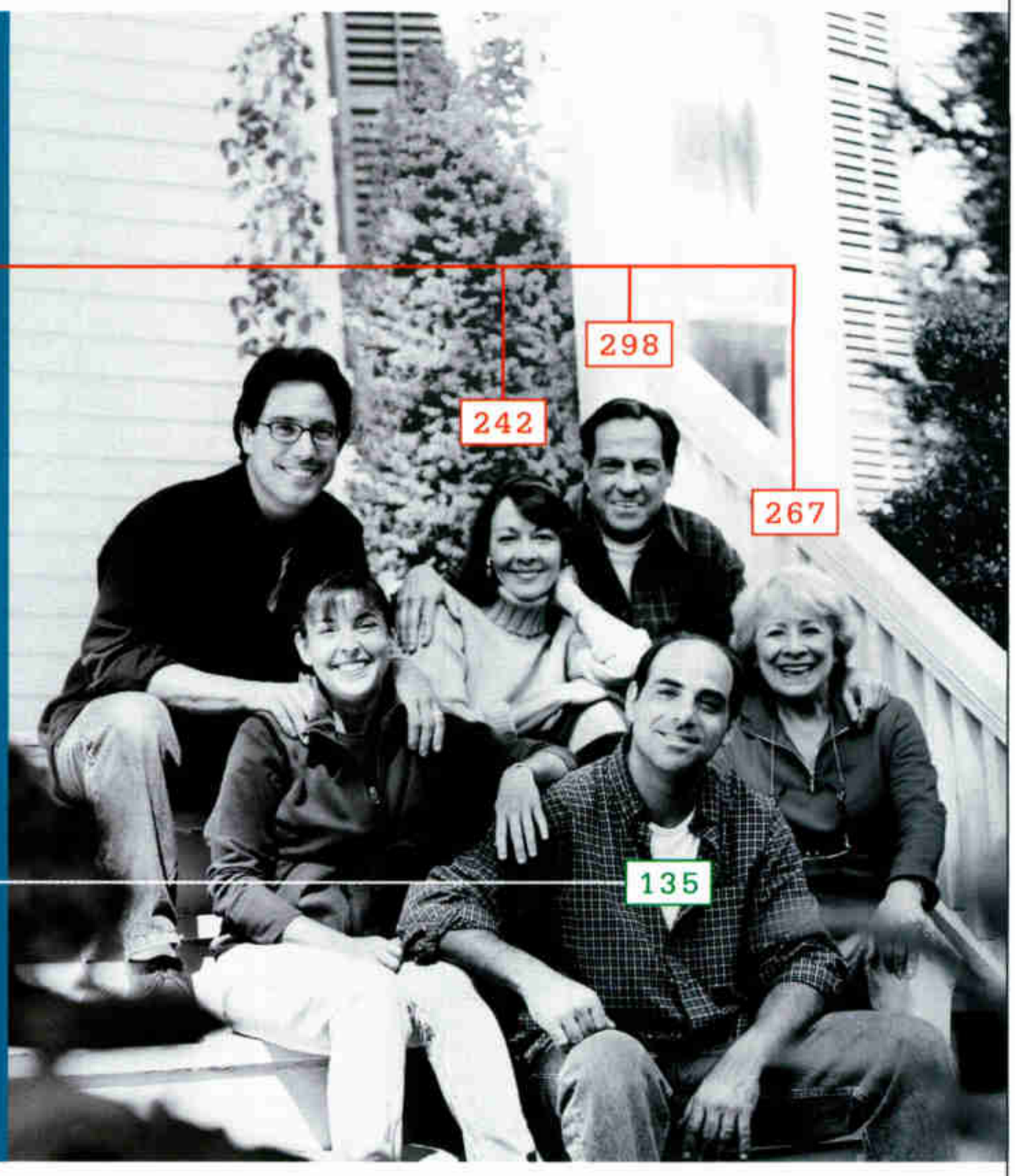
With their capital, Plymouth, up to its rooftops in ash as heavy as cement, and with many villages destroyed or off-limits, Montserratians are re-creating the landscape of their former lives—homes, schools, playgrounds, shops, offices, their hospital, the police station—in the safe zone, the once underdeveloped north.

"We were in a kind of limbo before," says Osborne, whose hotel is occupied these days by scientists. "But now we're rebuilding and getting on with our lives."

—*A. R. Williams*

Family history of high cholesterol.

Rewriting history.



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Please see additional important information on next page.

The bad news: high cholesterol may have as much to do with family genes as food. The good news: if diet and exercise aren't enough, adding LIPITOR can lower your total cholesterol 29% to 45% and your bad cholesterol 39% to 60% (average effect depending on dose). So shake up your tree a little. One in five people has high cholesterol and millions need treatment — talk to your doctor to find out if LIPITOR is right for you. To learn more, contact us at **1-888-LIPITOR** or **www.lipitor.com.**

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LIPITOR® (Atorvastatin Calcium) Tablets

Brief Summary of Prescribing Information

CONTRAINDICATIONS: Active liver disease or unexplained persistent elevations of serum transaminases. Hypersensitivity to any component of this medication. **Pregnancy and Lactation** — Atherosclerosis is a chronic process and discontinuation of lipid-lowering drugs during pregnancy should have little impact on the outcome of long-term therapy of primary hypercholesterolemia. Cholesterol and other products of cholesterol biosynthesis are essential components for fetal development (including synthesis of steroids and cell membranes). Since HMG-CoA reductase inhibitors decrease cholesterol synthesis and possibly the synthesis of other biologically active substances derived from cholesterol, they may cause fetal harm when administered to pregnant women. Therefore, HMG-CoA reductase inhibitors are contraindicated during pregnancy and in nursing mothers. ATORVASTATIN SHOULD BE ADMINISTERED TO WOMEN OF CHILDBEARING AGE ONLY WHEN SUCH PATIENTS ARE HIGHLY UNLIKELY TO CONCEIVE AND HAVE BEEN INFORMED OF THE POTENTIAL HAZARDS. If the patient becomes pregnant while taking this drug, therapy should be discontinued and the patient apprised of the potential hazard to the fetus.

WARNINGS: Liver Dysfunction — HMG-CoA reductase inhibitors, like some other lipid-lowering therapies, have been associated with biochemical abnormalities of liver function. **Persistent elevations (>3 times the upper limit of normal [ULN] occurring on 2 or more occasions) in serum transaminases occurred in 0.7% of patients who received atorvastatin in clinical trials. The incidence of these abnormalities was 0.2%, 0.2%, 0.6%, and 2.3% for 10, 20, 40, and 80 mg, respectively.** One patient in clinical trials developed jaundice. Increases in liver function tests (LFT) in other patients were not associated with jaundice or other clinical signs or symptoms. Upon dose reduction, drug interruption, or discontinuation, transaminase levels returned to or near pretreatment levels without sequelae. Eighteen of 30 patients with persistent LFT elevations continued treatment with a reduced dose of atorvastatin. **It is recommended that liver function tests be performed prior to and at 12 weeks following both the initiation of therapy and any elevation of dose, and periodically (eg, semiannually) thereafter.** Liver enzyme changes generally occur in the first 3 months of treatment with atorvastatin. Patients who develop increased transaminase levels should be monitored until the abnormalities resolve. Should an increase in ALT or AST of >3 times ULN persist, reduction of dose or withdrawal of atorvastatin is recommended. Atorvastatin should be used with caution in patients who consume substantial quantities of alcohol and/or have a history of liver disease. Active liver disease or unexplained persistent transaminase elevations are contraindications to the use of atorvastatin (see CONTRAINDICATIONS). **Skeletal Muscle — Rare cases of rhabdomyolysis with acute renal failure secondary to myoglobinuria have been reported with atorvastatin and with other drugs in this class.** Uncomplicated myalgia has been reported in atorvastatin-treated patients (see ADVERSE REACTIONS). Myopathy, defined as muscle aches or muscle weakness in conjunction with increases in creatine phosphokinase (CPK) values >10 times ULN, should be considered in any patient with diffuse myalgias, muscle tenderness or weakness, and/or marked elevation of CPK. Patients should be advised to report promptly unexplained muscle pain, tenderness or weakness, particularly if accompanied by malaise or fever. Atorvastatin therapy should be discontinued if markedly elevated CPK levels occur or myopathy is diagnosed or suspected. The risk of myopathy during treatment with drugs in this class is increased with concurrent administration of cyclosporine, fibric acid derivatives, erythromycin, niacin, or azole antifungals. Physicians considering combined therapy with atorvastatin and fibric acid derivatives, erythromycin, immunosuppressive drugs, azole antifungals, or lipid-lowering doses of niacin should carefully weigh the potential benefits and risks and should carefully monitor patients for any signs or symptoms of muscle pain, tenderness, or weakness, particularly during the initial months of therapy and during any periods of upward dosage titration of either drug. Periodic creatine phosphokinase (CPK) determinations may be considered in such situations, but there is no assurance that such monitoring will prevent the occurrence of severe myopathy. **Atorvastatin therapy should be temporarily withheld or discontinued in any patient with an acute, serious condition suggestive of a myopathy or having a risk factor predisposing to the development of renal failure secondary to rhabdomyolysis (eg, severe acute infection, hypotension, major surgery, trauma, severe metabolic, endocrine and electrolyte disorders, and uncontrolled seizures).**

PRECAUTIONS: General — Before instituting therapy with atorvastatin, an attempt should be made to control hypercholesterolemia with appropriate diet, exercise, and weight reduction in obese patients, and to treat other underlying medical problems (see INDICATIONS AND USAGE in full prescribing information). **Information for Patients** — Patients should be advised to report promptly unexplained muscle pain, tenderness, or weakness, particularly if accompanied by malaise or fever. **Drug Interactions** — The risk of myopathy during treatment with drugs of this class is increased with concurrent administration of cyclosporine, fibric acid derivatives, niacin (nicotinic acid), erythromycin, azole antifungals (see WARNINGS, Skeletal Muscle). ***Antacid:*** When atorvastatin and Maalox® TC suspension were coadministered, plasma concentrations of atorvastatin decreased approximately 35%. However, LDL-C reduction was not altered. ***Antipyrine:*** Because atorvastatin does not affect the pharmacokinetics of antipyrine, interactions with other drugs metabolized via the same cytochrome isozymes are not expected. ***Colestipol:*** Plasma concentrations of atorvastatin decreased approximately 25% when colestipol and atorvastatin were coadministered. However, LDL-C reduction was greater when atorvastatin and colestipol were coadministered than when either drug was given alone. ***Cimetidine:*** Atorvastatin plasma concentrations and LDL-C reduction were not altered by coadministration of cimetidine. ***Digoxin:*** When multiple doses of atorvastatin and digoxin were coadministered, steady-state plasma digoxin concentrations increased by approximately 20%. Patients taking digoxin should be monitored appropriately. ***Erythromycin:*** In healthy individuals, plasma concentrations of atorvastatin increased approximately 40% with coadministration of atorvastatin and erythromycin, a known inhibitor of cytochrome P450 3A4 (see WARNINGS, Skeletal Muscle). ***Oral Contraceptives:*** Coadministration of atorvastatin and an oral contraceptive increased AUC values for norethindrone and ethinyl estradiol by approximately 30% and 20%. These increases should be considered when selecting an oral contraceptive for a woman taking atorvastatin. ***Warfarin:*** Atorvastatin had no clinically significant effect on prothrombin time when administered to patients receiving chronic warfarin treatment. **Endocrine Function** — HMG-CoA reductase inhibitors interfere with cholesterol synthesis and theoretically might blunt adrenal and/or gonadal steroid production. Clinical studies have shown that atorvastatin does not reduce basal plasma cortisol concentration or impair adrenal reserve. The effects of HMG-CoA reductase inhibitors on male fertility have not been studied in adequate numbers of patients. The effects, if any, on the pituitary-gonadal axis in premenopausal women are unknown. Caution should be exercised if an HMG-CoA reductase inhibitor is administered concomitantly with drugs that may decrease the levels or activity of endogenous steroid hormones, such as ketoconazole, spironolactone, and cimetidine. **CNS Toxicity** — Brain hemorrhage was seen in a female dog treated for 3 months at 120 mg/kg/day. Brain hemorrhage and optic nerve vacuolation were seen in another female dog that was sacrificed in moribund condition after 11 weeks of escalating doses up to 280 mg/kg/day. The 120 mg/kg dose resulted in a systemic exposure approximately 16 times the human plasma area-under-the-curve (AUC, 0-24 hours) based on the maximum human dose of 80 mg/day. A single tonic convulsion was seen in each of 2 male dogs (one treated at 10 mg/kg/day and one at 120 mg/kg/day) in a 2-year study. No CNS lesions have been observed in mice after chronic treatment for up to 2 years at doses up to 400 mg/kg/day or in rats at doses up to 100 mg/kg/day. These doses were 6 to 11 times (mouse) and 8 to 16 times (rat) the human AUC (0-24) based on the maximum recommended human dose of 80 mg/day. CNS vascular lesions, characterized by perivascular hemorrhages, edema, and mononuclear cell infiltration of perivascular spaces, have been observed in dogs treated with other members of this class. A chemically similar drug in this class produced optic nerve degeneration (Wallerian degeneration of retinogeniculate fibers) in clinically normal dogs in a dose-dependent fashion at a dose that produced plasma drug levels about 30 times higher than the mean drug level in humans taking the highest recommended dose. **Carcinogenesis, Mutagenesis, Impairment of Fertility** — In a 2-year carcinogenicity study in rats at dose levels of 10, 30, and 100 mg/kg/day, 2 rare tumors were found in muscle in high-dose females: in one, there was a rhabdomyosarcoma and, in another, there was a fibrosarcoma. This dose represents a plasma AUC (0-24) value of approximately 16 times the mean human plasma drug exposure after an 80 mg oral dose. A 2-year carcinogenicity study in mice given 100, 200, or 400 mg/kg/day resulted in a significant increase in liver adenomas in high-dose males and liver carcinomas in high-dose females. These findings occurred at plasma AUC (0-24) values of approximately 6 times the mean human plasma drug exposure after an 80 mg oral dose. *In vitro*, atorvastatin was not mutagenic or clastogenic in the following tests with and without metabolic activation: the Ames test with *Salmonella typhimurium* and *Escherichia coli*, the HGPRT forward mutation assay in Chinese hamster lung cells, and the chromosomal aberration assay in Chinese hamster lung cells. Atorvastatin was negative in the *in vivo* mouse micronucleus test. Studies in rats performed at doses up to 175 mg/kg (15 times the human exposure) produced no changes in fertility. There was aplasia and aspermia in the epididymis of 2 of 10 rats treated with 100 mg/kg/day of atorvastatin for 3 months (16 times the human AUC at the 80 mg dose); testis weights were significantly lower at 30 and 100 mg/kg and epididymal weight was lower at 100 mg/kg. Male rats given 100 mg/kg/day for 11 weeks prior to mating had decreased sperm motility, spermatid head concentration, and increased abnormal sperm. Atorvastatin caused no adverse effects on semen parameters, or reproductive organ-histopathology in dogs given doses of 10, 40, or 120 mg/kg for two years. **Pregnancy — Pregnancy Category X:** **See CONTRAINDICATIONS.** Safety in pregnant women has not been established. Atorvastatin crosses the rat placenta and reaches a level in fetal liver equivalent to that of maternal plasma. Atorvastatin was not teratogenic in rats at doses up to 300 mg/kg/day or in rabbits at doses up to 100 mg/kg/day. These doses resulted in multiples of about 30 times (rat) or 20 times (rabbit) the human exposure based on surface area (mg/m^2). In a study in rats given 20, 100, or 225 mg/kg/day, from gestation day 7 through to lactation day 21 (weaning), there was decreased pup survival at birth, neonate, weaning, and maturity in pups of mothers dosed with 225 mg/kg/day. Body weight was decreased on days 4 and 21 in pups of mothers dosed at 100 mg/kg/day; pup body weight was decreased at birth and at days 4, 21, and 91 at 225 mg/kg/day. Pup development was delayed (rotorod performance at 100 mg/kg/day and acoustic startle at 225 mg/kg/day; pinnae detachment and eye opening at 225 mg/kg/day). These doses correspond to 6 times (100 mg/kg) and 22 times (225 mg/kg) the human AUC at 80 mg/day. Rare reports of congenital anomalies have been received following intrauterine exposure to HMG-CoA reductase inhibitors. There has been one report of severe congenital bony deformity, tracheo-esophageal fistula, and anal atresia (VATER association) in a baby born to a woman who took lovastatin with dextroamphetamine sulfate during the first trimester of pregnancy. LIPITOR should be administered to women of child-bearing potential only when such patients are highly unlikely to conceive and have been informed of the potential hazards. If the woman becomes pregnant while taking LIPITOR, it should be discontinued and the patient advised again as to the potential hazards to the fetus. **Nursing Mothers** — Nursing rat pups had plasma and liver drug levels of 50% and 40%, respectively, of that in their mother's milk. Because of the potential for adverse reactions in nursing infants, women taking LIPITOR should not breastfeed (see CONTRAINDICATIONS). **Pediatric Use** — Treatment experience in a pediatric population is limited to doses of LIPITOR up to 80 mg/day for 1 year in 8 patients with homozygous FH. No clinical or biochemical abnormalities were reported in these patients. None of these patients was below 9 years of age. **Geriatric Use** — The safety and efficacy of atorvastatin (10-80 mg) in the geriatric population (≥65 years of age) was evaluated in the ACCESS study. In this 54-week open-label trial 1,958 patients initiated therapy with atorvastatin 10 mg. Of these, 835 were elderly (≥65 years) and 1,123 were non-elderly. The mean change in LDL-C from baseline after 6 weeks of treatment with atorvastatin 10 mg was -38.2% in the elderly patients versus -34.6% in the non-elderly group. The rates of discontinuation due to adverse events were similar between the two age groups. There were no differences in clinically relevant laboratory abnormalities between the age groups.

ADVERSE REACTIONS: LIPITOR is generally well tolerated. Adverse reactions have usually been mild and transient. In controlled clinical studies of 2502 patients, <2% of patients were discontinued due to adverse experiences attributable to atorvastatin. The most frequent adverse events thought to be related to atorvastatin were constipation, flatulence, dyspepsia, and abdominal pain. **Clinical Adverse Experiences** — Adverse experiences reported in ≥2% of patients in placebo-controlled clinical studies of atorvastatin, regardless of causality assessment, are shown in the following table.

Adverse Events in Placebo-Controlled Studies (% of Patients)

BODY SYSTEM Adverse Event	Placebo N = 270	Atorvastatin 10 mg N = 863	Atorvastatin 20 mg N = 36	Atorvastatin 40 mg N = 79	Atorvastatin 80 mg N = 94
BODY AS A WHOLE					
Infection	10.0	10.3	2.8	10.1	7.4
Headache	7.0	5.4	16.7	2.5	6.4
Accidental Injury	3.7	4.2	0.0	1.3	3.2
Flu Syndrome	1.9	2.2	0.0	2.5	3.2
Abdominal Pain	0.7	2.8	0.0	3.8	2.1
Back Pain	3.0	2.8	0.0	3.8	1.1
Allergic Reaction	2.6	0.9	2.8	1.3	0.0
Asthenia	1.9	2.2	0.0	3.8	0.0
DIGESTIVE SYSTEM					
Constipation	1.8	2.1	0.0	2.5	1.1
Diarrhea	1.5	2.7	0.0	3.8	5.3
Dyspepsia	4.1	2.3	2.8	1.3	2.1
Flatulence	3.3	2.1	2.8	1.3	1.1
RESPIRATORY SYSTEM					
Sinusitis	2.6	2.8	0.0	2.5	6.4
Pharyngitis	1.5	2.5	0.0	1.3	2.1
SKIN AND APPENDAGES					
Rash	0.7	3.9	2.8	3.8	1.1
MUSCULOSKELETAL SYSTEM					
Arthralgia	1.5	2.0	0.0	5.1	0.0
Myalgia	1.1	3.2	5.6	1.3	0.0

The following adverse events were reported, regardless of causality assessment in patients treated with atorvastatin in clinical trials. The events in italics occurred in ≥2% of patients and the events in plain type occurred in <2% of patients.

Body as a Whole: *Chest pain*, face edema, fever, neck rigidity, malaise, photosensitivity reaction, generalized edema. ***Digestive System:*** *Nausea*, gastroenteritis, liver function tests abnormal, colitis, vomiting, gastritis, dry mouth, rectal hemorrhage, esophagitis, eructation, glossitis, mouth ulceration, anorexia, increased appetite, stomatitis, biliary pain, cheilitis, duodenal ulcer, dysphagia, enteritis, melena, gum hemorrhage, stomach ulcer, tenesmus, ulcerative stomatitis, hepatitis, pancreatitis, cholestatic jaundice. ***Respiratory System:*** *Bronchitis, rhinitis*, pneumonia, dyspnea, asthma, epistaxis. ***Nervous System:*** *Insomnia, dizziness*, paresthesia, somnolence, amnesia, abnormal dreams, libido decreased, emotional lability, incoordination, peripheral neuropathy, torticollis, facial paralysis, hyperkinesia, depression, hypesthesia, hypertonia. ***Musculoskeletal System:*** *Arthritis*, leg cramps, bursitis, tenosynovitis, myasthenia, tendinous contracture, myositis. ***Skin and Appendages:*** Pruritus, contact dermatitis, alopecia, dry skin, sweating, acne, urticaria, eczema, seborrhea, skin ulcer. ***Urogenital System:*** *Urinary tract infection*, urinary frequency, cystitis, hematuria, impotence, dysuria, kidney calculus, nocturia, epididymitis, fibrocystic breast, vaginal hemorrhage, albuminuria, breast enlargement, metrorrhagia, nephritis, urinary incontinence, urinary retention, urinary urgency, abnormal ejaculation, uterine hemorrhage. ***Special Senses:*** Amblyopia, tinnitus, dry eyes, refraction disorder, eye hemorrhage, deafness, glaucoma, parosmia, taste loss, taste perversion. ***Cardiovascular System:*** Palpitation, vasodilatation, syncope, migraine, postural hypotension, phlebitis, arrhythmia, angina pectoris, hypertension. ***Metabolic and Nutritional Disorders:*** *Peripheral edema*, hyperglycemia, creatine phosphokinase increased, gout, weight gain, hypoglycemia. ***Hemic and Lymphatic System:*** Ecchymosis, anemia, lymphadenopathy, thrombocytopenia, petechia. ***Postintroduction Reports*** — Adverse events associated with LIPITOR therapy reported since market introduction, that are not listed above, regardless of causality assessment, include the following: anaphylaxis, angioneurotic edema, bullous rashes (including erythema multiforme, Stevens-Johnson syndrome, and toxic epidermal necrolysis), and rhabdomyolysis.

OVERDOSAGE: There is no specific treatment for atorvastatin overdosage. In the event of an overdose, the patient should be treated symptomatically, and supportive measures instituted as required. Due to extensive drug binding to plasma proteins, hemodialysis is not expected to significantly enhance atorvastatin clearance.

Please see full prescribing information for more information about LIPITOR.

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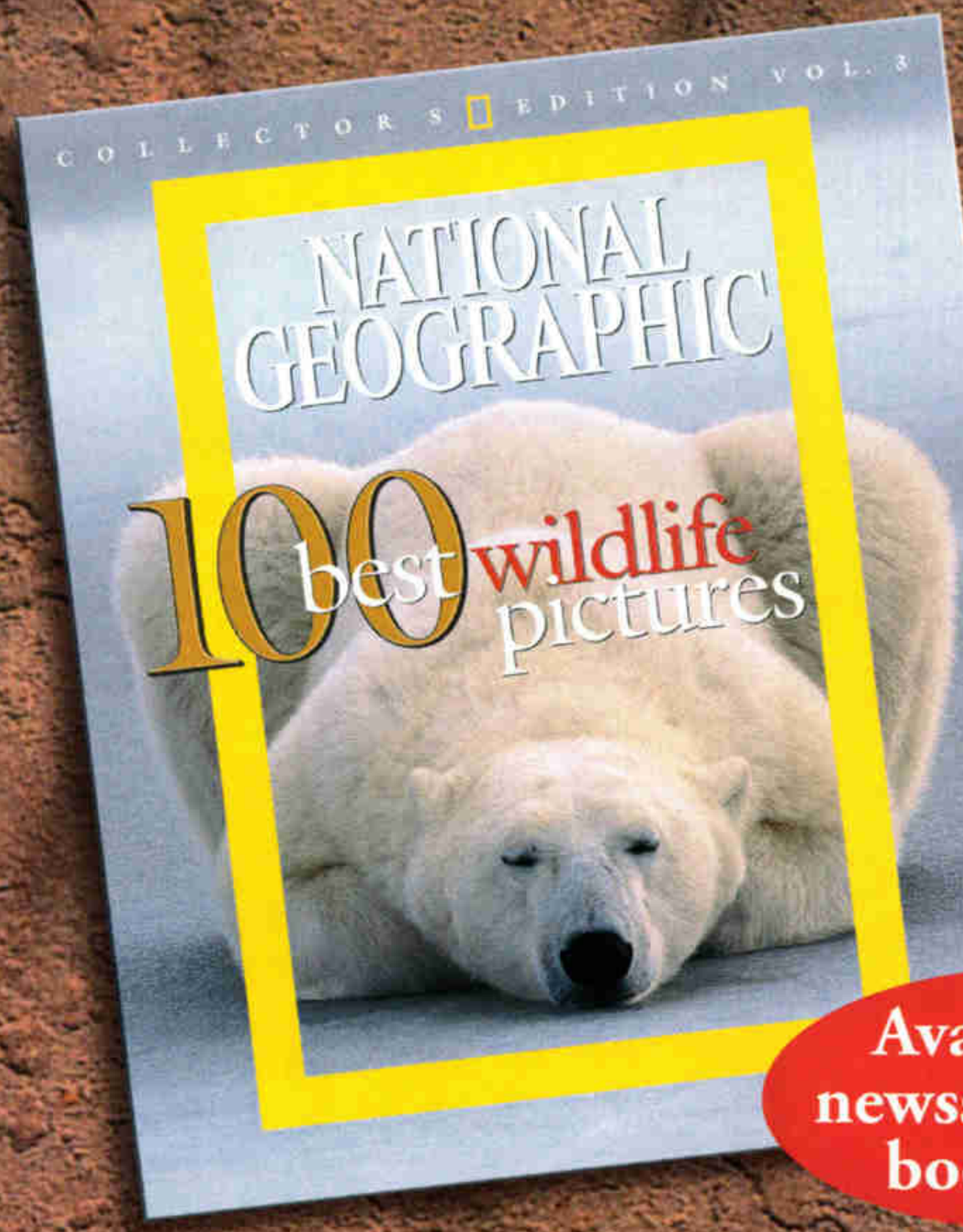

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CONSERVATION

New Species Losing Ground

There's little sage left for the Gunnison sage grouse

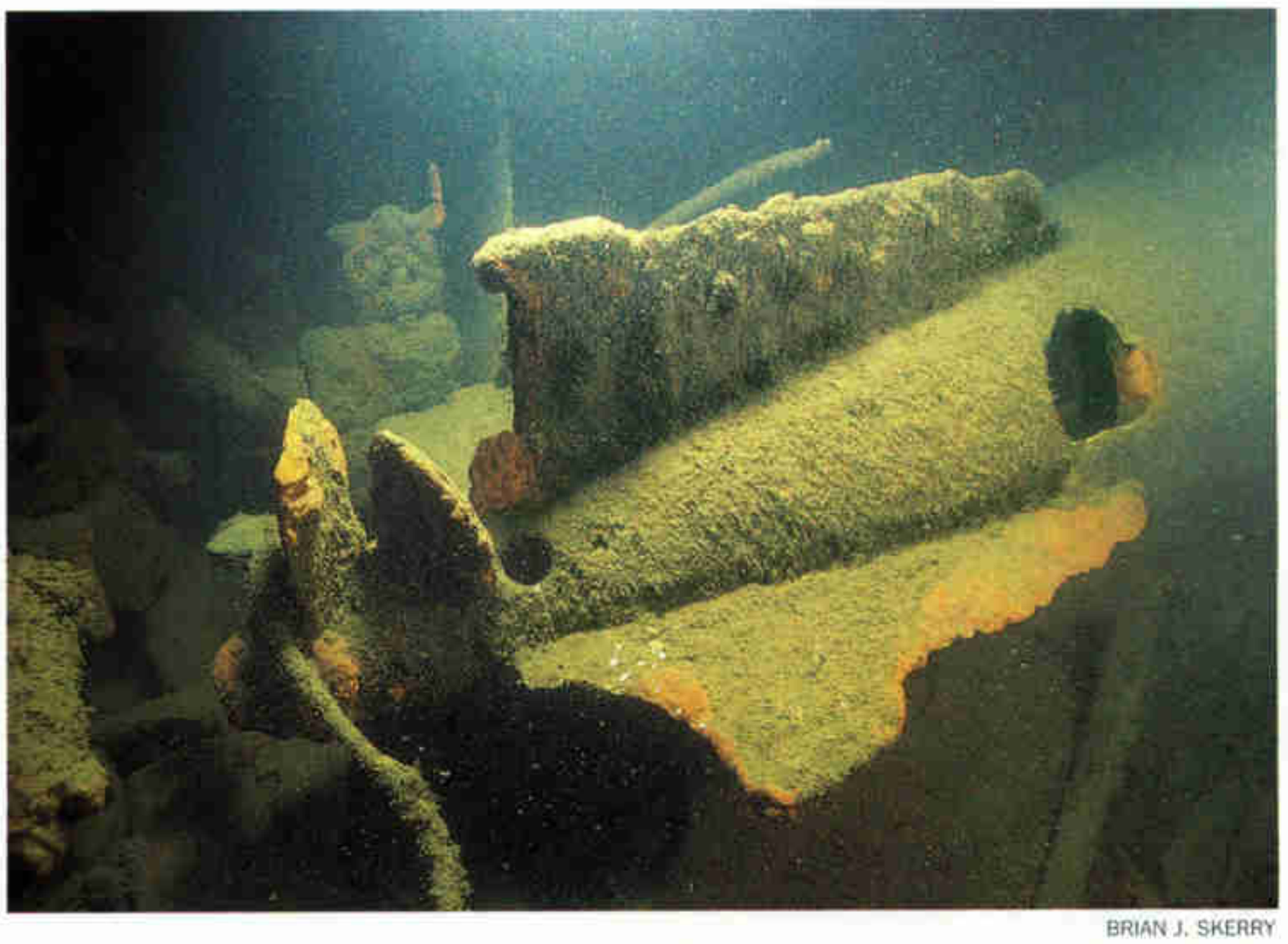
JOEL SARTORE (BOTH)

"Like a pot of boiling water" is how Jessica Young of Western State College of Colorado describes the sounds of male Gunnison sage grouse like these (above) trying to attract females. Young helped describe the grouse, recently separated as a new species from the more abundant northern sage grouse. Numbering fewer than 4,000, Gunnisons already are candidates for the endangered species list. The birds live in only seven Colorado counties and one in Utah. They've lost much of their habitat to roads, reservoirs, and ranches. "Their entire lives are tied to sagebrush for food and shelter," says Young.

—John L. Eliot

HISTORY

Truth Surfaces About A Nazi Submarine



BRIAN J. SKERRY

Anxiety about homeland security is nothing new: In World War II, German submarines haunted America's East Coast. *U-853*, the last U-boat sunk in the war, was among them—it lies only seven miles off Rhode Island (right), one of two dozen known German U-boat wrecks in U.S. waters. Now the ghost of *U-853* is back: After 56 years the U.S. Navy has acknowledged one of the U-boat's last kills, a Navy ship that sank late in the war.

On April 23, 1945—two weeks before Germany surrendered—an explosion ripped U.S.S. *Eagle (PE-56)* as it sat off the coast of Maine, sending a geyser of water 300 feet in the air and killing 49 of its 62 crewmen. A 200-foot-long World War I–era "sub chaser," the craft was being used that day to haul targets for bombing practice by Navy pilots.

A Navy Court of Inquiry ruled that *PE-56*'s boiler had exploded and that the cause was "not enemy action," despite the accounts of crewmen who saw a sub surface soon after the explosion. Some described a conning tower carrying red and yellow markings like the insignia of *U-853* (the image of a red horse on a yellow shield). Twelve days—and one additional kill—later the sub was destroyed by a massive barrage of depth charges near Block Island.

Paul Lawton, a Brockton, Massachusetts, naval historian, began investigating the case in 1998 and gave his findings to the Navy, which has finally reclassified *PE-56*'s sinking as an enemy sub attack.

—Cliff Tarpy

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NGS RESEARCH GRANT

The Beauty of a Full Figure

At Sha'ar Hagolan, pottery goddesses held power

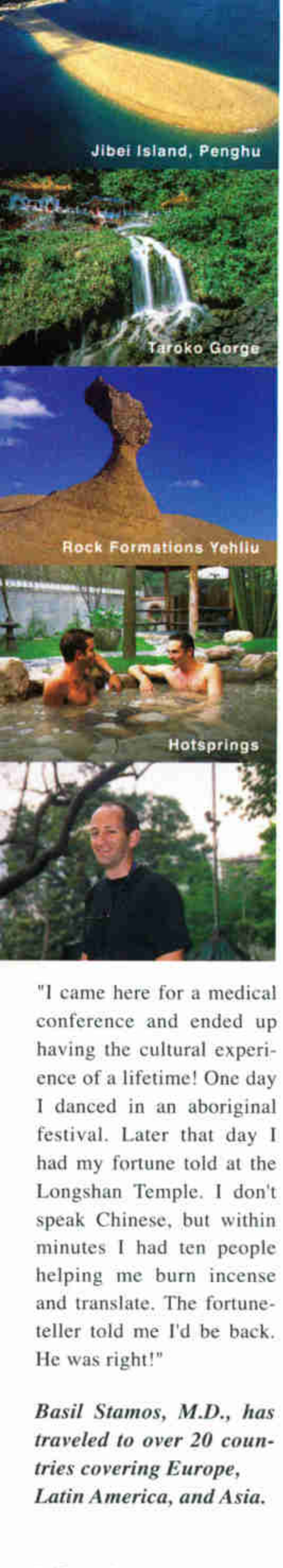
Want to be worshiped? If you lived 8,000 years ago in the Neolithic-era settlement of Sha'ar Hagolan, now in modern-day Israel, you would have needed long, squinty eyes, massive thighs, and rippling folds of belly fat. More than a hundred such pottery "mother goddess" figurines (left)—made when fired-clay pottery was a new technology in the Middle East—are among the artifacts found by archaeologist Yosef Garfinkel of Hebrew University at the site near the Sea of Galilee.

Few details are known about the spiritual life of these ancient people. Their community life "certainly included dancing," Garfinkel says, and probably rituals connected to the agricultural cycle. Sha'ar Hagolan was once the largest settlement in the Middle East. "It was a major cultural center, like New York or London today," he says.

The seated figurines, created in elegant, stylized designs by skilled craftsmen, may have been created to help ensure the fertility of the land and the people, but they seem to have had a protective aspect as well. Because they have been discovered in every building his team excavated, Garfinkel believes the figurines were in routine household use.

—Margaret G. Zackowitz

DAVID HARRIS



"I came here for a medical conference and ended up having the cultural experience of a lifetime! One day I danced in an aboriginal festival. Later that day I had my fortune told at the Longshan Temple. I don't speak Chinese, but within minutes I had ten people helping me burn incense and translate. The fortune-teller told me I'd be back. He was right!"

Basil Stamos, M.D., has traveled to over 20 countries covering Europe, Latin America, and Asia.

Did you know?

Taiwan boasts over 5,000 temples, covering Taoist, Buddhist, Confucian, and 'local' religions. The locals here say, "Every day is at least one god's birthday." That means, no matter when you come, there is sure to be some festivals or celebrations for you to enjoy!

Double Dragon Plate,
The National Palace Museum

Taiwan, Expect the Unexpected!

Taiwan is a land of exciting contrasts and surprises. As one of Asia's industrially advanced "Little Dragons," Taiwan offers all the comforts and conveniences Western travelers demand. But beneath that modern set of scales is a heart that's traditionally Chinese. The National Palace Museum boasts the largest and greatest collection of Chinese art in the world and outside this treasure trove you'll find the most preserved, alive, and thriving Chinese culture, festivals, and traditions anywhere. But it's still Taiwan, and that means Taiwanese and aboriginal culture, events, and food you can't find anywhere else!

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CONSERVATION

Nets Snaring Rare Dolphins

New Zealand weighs legislation for tiny population

INGRID N. VISSER

New Zealanders call those rounded dorsal fins (above) Mickey Mouse ears. They belong to Hector's dolphins, the smallest—and perhaps the rarest—marine dolphin species in the world. The dolphins swim only in the nearshore waters of the North and South Islands, New Zealand's main landmasses. Unfortunately, that's where many fishermen cast their nets, looking for rig, a small shark species used for fish and chips.

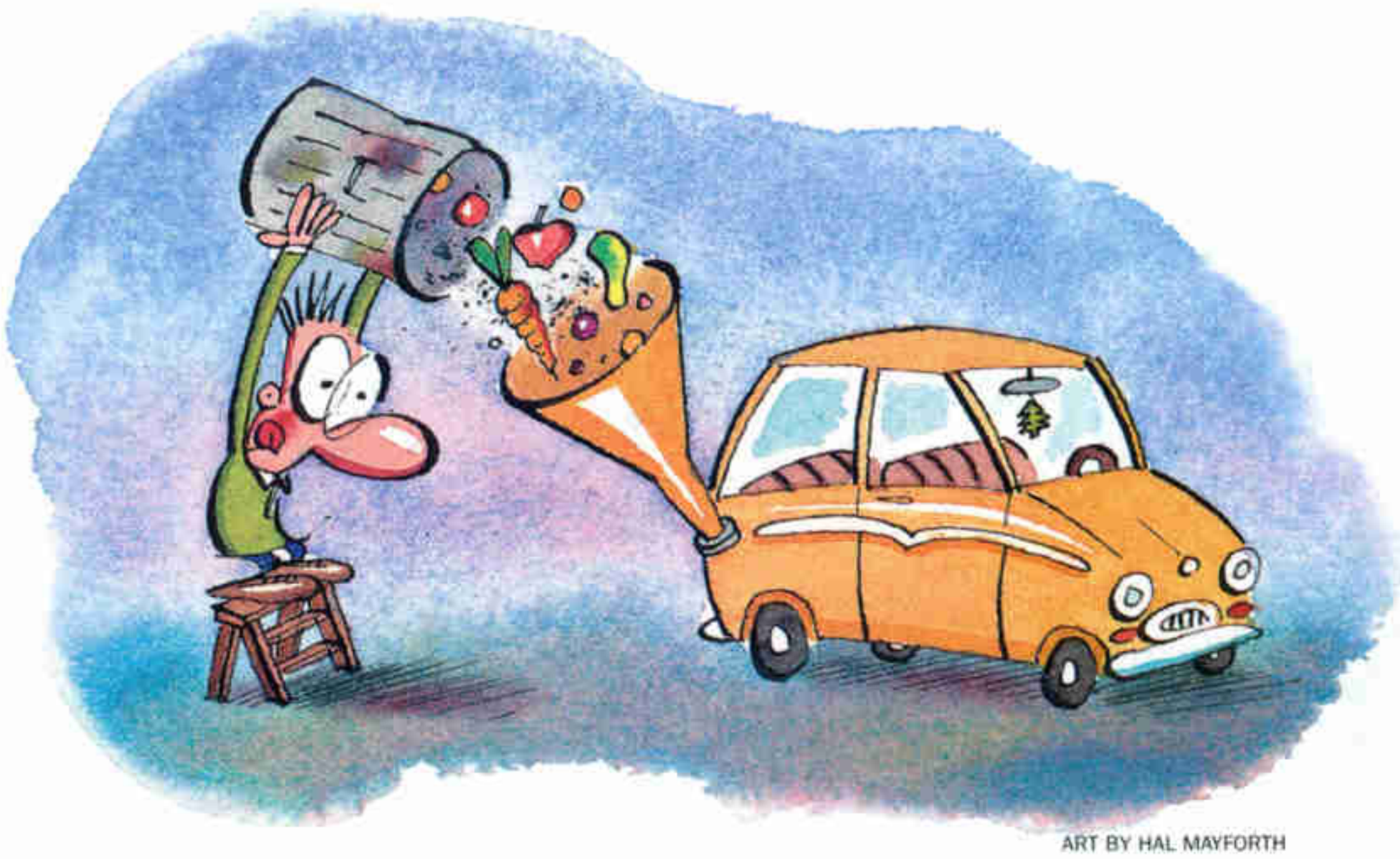
About 7,000 Hector's dolphins live along the South Island coastline, including these animals swimming off Kaikoura. The critically endangered and genetically distinct North Island population numbers only about a hundred. "Last February three dead dolphins were found on North Island beaches," says Sam DuFresne of the University of Otago. Two of these animals bore marks from fishermen's gill nets. The dolphins become entangled in the nets and drown.

Last March a New Zealand court overturned a decision to halt fishing with gill nets in a large area of North Island waters used by Hector's dolphins. Now the government, conservationists, and fishermen are negotiating a new plan to try to save the world's smallest dolphin.

—John L. Eliot

ENVIRONMENT

Food for the Road



ART BY HAL MAYFORTH

Fill 'er up with rotten vegetables: A prototype for a Swiss sports car called the Rinspeed R One gets its power from a biogas made of methane fermented from kitchen and garden waste. It can run for about 60 miles on 220 pounds of waste while producing less carbon dioxide than gasoline.

These biogas cars aren't on the road yet, but thousands of other food-recycling vehicles are. In the U.S. more than 200 fleets of vehicles are running on biodiesel made from vegetable oil. Any diesel engine can burn it with less soot than regular diesel. Twenty million gallons of biodiesel fuel are sold annually in the U.S. Nearly 10 percent is made from recycled restaurant grease. "The number of restaurants has grown so much," says K. Shaine Tyson of the National Renewable Energy Lab, "there's excess cooking oil available to make more than 400 million gallons of biodiesel." An added attraction (or not): Biodiesel cars can smell a bit like french fries. *—John L. Eliot*

July 18, 2006

Zoomi Danlami, 4, died of being born in the wrong place. Because of poverty, malnutrition and poor medical conditions, Zoomi didn't have a chance. She is survived by her mother, who was powerless to help her, and by all of us who could have helped prevent her demise.

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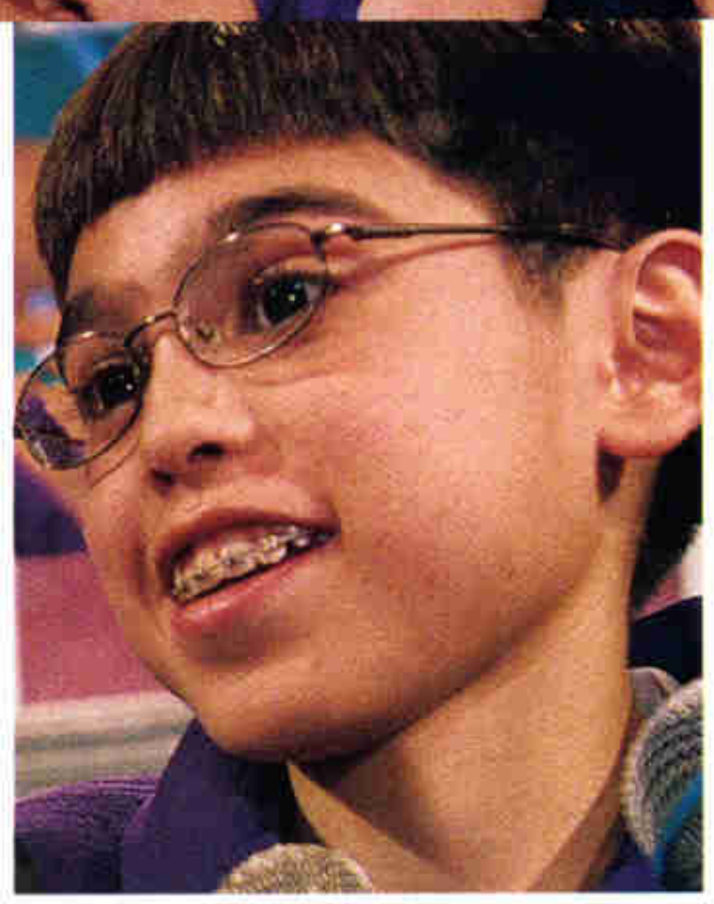
Behind the SCENES

AT THE NATIONAL GEOGRAPHIC SOCIETY

The Agony of the Bee

Champ cool under fire

Now *this* is stress: You're just a kid, and you're competing in the 14th annual National Geographic Bee. If you're a top-ten finalist, you're on national television, the bright lights are on, and *Jeopardy!* host Alex Trebek is tossing you brutal questions. And then there's the $25,000 college scholarship that goes to the winner. No wonder the strain shows on the faces of (top, from left) Brock Haroldson, 14, of Aztec, New Mexico; Erik Miller, 14, of Kent, Washington; Matthew Russell, 14, of Bradford, Pennsylvania; and Zia Choudhury, 11, of Paducah, Kentucky.



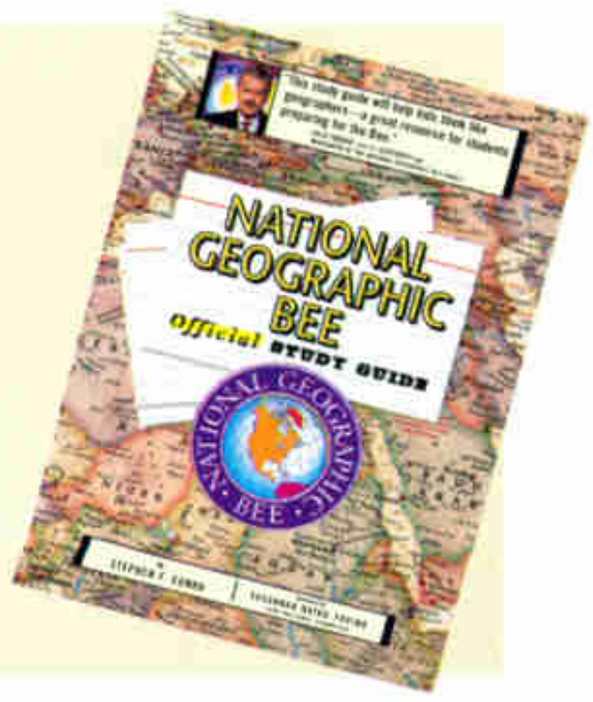
ALL BY MARK THIESSEN, NGS

Needless to say, the one smiling face (above) belongs to the champion, Calvin McCarter, a preternaturally calm 10-year-old from Jenison, Michigan, who correctly placed Lop Nur, the site of a nuclear test range, in China to claim the honor. Calvin allowed later as how he got "a little nervous, but not much." His mother, Charlotte, who teaches Calvin at home, said she herself was weak in geography but relied on her older son, Parnell, 12, to bolster Calvin's geographic knowledge. Parnell had hoped to reach the national finals himself but had the bad luck to compete against his brother at the school level. "Calvin beat me," he said.

Twelve of the 55 national finalists who came to Washington, D.C., had made the national cut before. All were survivors of competitions at the school and state levels that included almost five million entrants.

Get Ready for Next Year's Geographic Bee

Know a kid who dreams of following Calvin McCarter into the winner's circle? Here's a new tool to help: *National Geographic Bee Official Study Guide.* Author Stephen F. Cunha, geography professor at Humboldt State University and the Bee's California state coordinator, reviews questions, maps, graphs, and photos used in actual Bees and offers hints about how to answer stumpers. The guide's foreword is by Susannah Batko-Yovino, 1990 *Bee champion*—the only female winner.



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ARICEPT® is well tolerated but may not be for everyone. Some people may experience nausea, diarrhea, insomnia, vomiting, muscle cramps, fatigue or loss of appetite. In studies, these side effects were usually mild and temporary. Some people taking ARICEPT® may experience fainting. People at risk for ulcers should tell their doctors because their condition may get worse.

Only a doctor can say if memory problems are due to Alzheimer's disease. And the sooner you know, the sooner ARICEPT® may help. So speak to a doctor today and ask about ARICEPT®, the #1 prescribed medicine for Alzheimer's disease.

SEE A DOCTOR AND ASK ABOUT

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Brief Summary—see package insert for full prescribing information. **INDICATIONS AND USAGE** ARICEPT® is indicated for the treatment of mild to moderate dementia of the Alzheimer's type. **CONTRAINDICATIONS** ARICEPT® is contraindicated in patients with known hypersensitivity to donepezil hydrochloride or to piperidine derivatives. **WARNINGS** ***Anesthesia:*** ARICEPT®, as a cholinesterase inhibitor, is likely to exaggerate succinylcholine-type muscle relaxation during anesthesia. ***Cardiovascular Conditions:*** Because of their pharmacological action, cholinesterase inhibitors may have vagotonic effects on the sinoatrial and atrioventricular nodes. This effect may manifest as bradycardia or heart block in patients both with and without known underlying cardiac conduction abnormalities. Syncopal episodes have been reported in association with the use of ARICEPT®. ***Gastrointestinal Conditions:*** Through their primary action, cholinesterase inhibitors may be expected to increase gastric acid secretion due to increased cholinergic activity. Therefore, patients should be monitored closely for symptoms of active or occult gastrointestinal bleeding, especially those at increased risk for developing ulcers, e.g., those with a history of ulcer disease or those receiving concurrent nonsteroidal anti-inflammatory drugs (NSAIDS). Clinical studies of ARICEPT® have shown no increase, relative to placebo, in the incidence of either peptic ulcer disease or gastrointestinal bleeding. ARICEPT®, as a predictable consequence of its pharmacological properties, has been shown to produce diarrhea, nausea and vomiting. These effects, when they occur, appear more frequently with the 10 mg/day dose than with the 5 mg/day dose. In most cases, these effects have been mild and transient, sometimes lasting one to three weeks, and have resolved during continued use of ARICEPT®. ***Genitourinary:*** Although not observed in clinical trials of ARICEPT®, cholinomimetics may cause bladder outflow obstruction. ***Neurological Conditions:*** Seizures: Cholinomimetics are believed to have some potential to cause generalized convulsions. However, seizure activity also may be a manifestation of Alzheimer's Disease. ***Pulmonary Conditions:*** Because of their cholinomimetic actions, cholinesterase inhibitors should be prescribed with care to patients with a history of asthma or obstructive pulmonary disease. **PRECAUTIONS Drug-Drug Interactions** ***Drugs Highly Bound to Plasma Proteins:*** Drug displacement studies have been performed *in vitro* between this highly bound drug (96%) and other drugs such as furosemide, digoxin, and warfarin. ARICEPT® at concentrations of 0.3-10 µg/mL did not affect the binding of furosemide (5 µg/mL), digoxin (2 ng/mL), and warfarin (3 µg/mL) to human albumin. Similarly, the binding of ARICEPT® to human albumin was not affected by furosemide, digoxin, and warfarin. ***Effect of ARICEPT® on the Metabolism of Other Drugs:*** No *in vivo* clinical trials have investigated the effect of ARICEPT® on the clearance of drugs metabolized by CYP 3A4 (e.g. cisapride, terfenadine) or by CYP 2D6 (e.g. imipramine). However, *in vitro* studies show a low rate of binding to these enzymes (mean K_i about 50-130 µM), that, given the therapeutic plasma concentrations of donepezil (164 nM), indicates little likelihood of interference. Whether ARICEPT® has any potential for enzyme induction is not known. ***Effect of Other Drugs on the Metabolism of ARICEPT®:*** Ketoconazole and quinidine, inhibitors of CYP450, 3A4 and 2D6, respectively, inhibit donepezil metabolism *in vitro*. Whether there is a clinical effect of these inhibitors is not known. Inducers of CYP 2D6 and CYP 3A4 (e.g., phenytoin, carbamazepine, dexamethasone, rifampin, and phenobarbital) could increase the rate of elimination of ARICEPT®. ***Use with Anticholinergics:*** Because of their mechanism of action, cholinesterase inhibitors have the potential to interfere with the activity of anticholinergic medications. ***Use with Cholinomimetics and Other Cholinesterase Inhibitors:*** A synergistic effect may be expected when cholinesterase inhibitors are given concurrently with succinylcholine, similar neuromuscular blocking agents or cholinergic agonists such as bethanechol. **Carcinogenesis, Mutagenesis, Impairment of Fertility** Carcinogenicity studies of donepezil have not been completed. Donepezil was not mutagenic in the Ames reverse mutation assay in bacteria. In the chromosome aberration test in cultures of Chinese hamster lung (CHL) cells, some clastogenic effects were observed. Donepezil was not clastogenic in the *in vivo* mouse micronucleus test. Donepezil had no effect on fertility in rats at doses up to 10 mg/kg/day (approximately 8 times the maximum recommended human dose on a mg/m² basis). **Pregnancy** ***Pregnancy Category C:*** Teratology studies conducted in pregnant rats at doses up to 16 mg/kg/day (approximately 13 times the maximum recommended human dose on a mg/m² basis) and in pregnant rabbits at doses up to 10 mg/kg/day (approximately 16 times the maximum recommended human dose on a mg/m² basis) did not disclose any evidence for a teratogenic potential of donepezil. However, in a study in which pregnant rats were given up to 10 mg/kg/day (approximately 8 times the maximum recommended human dose on a mg/m² basis) from day 17 of gestation through day 20 postpartum, there was a slight increase in still births and a slight decrease in pup survival through day 4 postpartum at this dose; the next lower dose tested was 3 mg/kg/day. There are no adequate or well-controlled studies in pregnant women. ARICEPT® should be used during pregnancy only if the potential benefit justifies the potential risk to the fetus. **Nursing Mothers** It is not known whether donepezil is excreted in human breast milk. ARICEPT® has no indication for use in nursing mothers. **Pediatric Use** There are no adequate and well-controlled trials to document the safety and efficacy of ARICEPT® in any illness occurring in children. **ADVERSE REACTIONS Adverse Events Leading to Discontinuation** The rates of discontinuation from controlled clinical trials of ARICEPT® due to adverse events for the ARICEPT® 5 mg/day treatment groups were comparable to those of placebo-treatment groups at approximately 5%. The rate of discontinuation of patients who received 7-day escalations from 5 mg/day to 10 mg/day, was higher at 13%. The most common adverse events leading to discontinuation, defined as those occurring in at least 2% of patients and at twice the incidence seen in placebo patients, are shown in Table 1.

Table 1. Most Frequent Adverse Events Leading to Withdrawal from Controlled Clinical Trials by Dose Group

Dose Group	Placebo	5 mg/day ARICEPT®	10 mg/day ARICEPT®
Patients Randomized	355	350	315
Event/%Discontinuing			
Nausea	1%	1%	3%
Diarrhea	0%	<1%	3%
Vomiting	<1%	<1%	2%

Most Frequent Adverse Clinical Events Seen in Association with the Use of ARICEPT® The most common adverse events, defined as those occurring at a frequency of at least 5% in patients receiving 10 mg/day and twice the placebo rate, are largely predicted by ARICEPT®'s cholinomimetic effects. These include nausea, diarrhea, insomnia, vomiting, muscle cramp, fatigue and anorexia. These adverse events were often of mild intensity and transient, resolving during continued ARICEPT® treatment without the need for dose modification. There is evidence to suggest that the frequency of these common adverse events may be affected by the rate of titration. An open-label study was conducted with 269 patients who received placebo in the 15- and 30-week studies. These patients were titrated to a dose of 10 mg/day over a 6-week period. The rates of common adverse events were lower than those seen in patients titrated to 10 mg/day over one week in the controlled clinical trials and were comparable to those seen in patients on 5 mg/day. See Table 2 for a comparison of the most common adverse events following one and six week titration regimens.

Table 2. Comparison of Rates of Adverse Events in Patients Titrated to 10 mg/day Over 1 and 6 Weeks

	No titration		One-week titration	Six-week titration
Adverse Event	**Placebo (n=315)**	**5 mg/day (n=311)**	**10 mg/day (n=315)**	**10 mg/day (n=269)**
Nausea	6%	5%	19%	6%
Diarrhea	5%	8%	15%	9%
Insomnia	6%	6%	14%	6%
Fatigue	3%	4%	8%	3%
Vomiting	3%	3%	8%	5%
Muscle cramps	2%	6%	8%	3%
Anorexia	2%	3%	7%	3%

Adverse Events Reported in Controlled Trials The events cited reflect experience gained under closely monitored conditions of clinical trials in a highly selected patient population. In actual clinical practice or in other clinical trials, these frequency estimates may not apply, as the conditions of use, reporting behavior, and the kinds of patients treated may differ. Table 3 lists treatment emergent signs and symptoms that were reported in at least 2% of patients in placebo-controlled trials who received ARICEPT® and for which the rate of occurrence was greater for ARICEPT® assigned than placebo assigned patients. In general, adverse events occurred more frequently in female patients and with advancing age.

Table 3. Adverse Events Reported in Controlled Clinical Trials in at Least 2% of Patients Receiving ARICEPT® (donepezil HCl) and at a Higher Frequency than Placebo-treated Patients

Body System/Adverse Event	Placebo (n=355)	ARICEPT® (n=747)
Percent of Patients with any Adverse Event	**72**	**74**
Body as a Whole		
Headache	9	10
Pain, various locations	8	9
Accident	6	7
Fatigue	3	5
Cardiovascular System		
Syncope	1	2
Digestive System		
Nausea	6	11
Diarrhea	5	10
Vomiting	3	5
Anorexia	2	4
Hemic and Lymphatic System		
Ecchymosis	3	4
Metabolic and Nutritional Systems		
Weight Decrease	1	3
Musculoskeletal System		
Muscle Cramps	2	6
Arthritis	1	2
Nervous System		
Insomnia	6	9
Dizziness	6	8
Depression	<1	3
Abnormal Dreams	0	3
Somnolence	<1	2
Urogenital System		
Frequent Urination	1	2

Other Adverse Events Observed During Clinical Trials ARICEPT® has been administered to over 1700 individuals during clinical trials worldwide. Approximately 1200 of these patients have been treated for at least 3 months and more than 1000 patients have been treated for at least 6 months. Controlled and uncontrolled trials in the United States included approximately 900 patients. In regards to the highest dose of 10 mg/day, this population includes 650 patients treated for 3 months, 475 patients treated for 6 months and 116 patients treated for over 1 year. The range of patient exposure is from 1 to 1214 days. Treatment emergent signs and symptoms that occurred during 3 controlled clinical trials and two open-label trials in the United States were recorded as adverse events by the clinical investigators using terminology of their own choosing. To provide an overall estimate of the proportion of individuals having similar types of events, the events were grouped into a smaller number of standardized categories using a modified COSTART dictionary and event frequencies were calculated across all studies. These categories are used in the listing below. The frequencies represent the proportion of 900 patients from these trials who experienced that event while receiving ARICEPT®. All adverse events occurring at least twice are included, except for those already listed in Tables 2 or 3, COSTART terms too general to be informative, or events less likely to be drug caused. Events are classified by body system and listed using the following definitions: *frequent adverse events*—those occurring in at least 1/100 patients; *infrequent adverse events*—those occurring in 1/100 to 1/1000 patients. These adverse events are not necessarily related to ARICEPT® treatment and in most cases were observed at a similar frequency in placebo-treated patients in the controlled studies. No important additional adverse events were seen in studies conducted outside the United States. **Body as a Whole:** *Frequent:* influenza, chest pain, toothache; *Infrequent:* fever, edema face, periorbital edema, hernia hiatal, abscess, cellulitis, chills, generalized coldness, head fullness, listlessness. **Cardiovascular System:** *Frequent:* hypertension, vasodilation, atrial fibrillation, hot flashes, hypotension; *Infrequent:* angina pectoris, postural hypotension, myocardial infarction, AV block (first degree), congestive heart failure, arteritis, bradycardia, peripheral vascular disease, supraventricular tachycardia, deep vein thrombosis. **Digestive System:** *Frequent:* fecal incontinence, gastrointestinal bleeding, bloating, epigastric pain; *Infrequent:* eructation, gingivitis, increased appetite, flatulence, periodontal abscess, cholelithiasis, diverticulitis, drooling, dry mouth, fever sore, gastritis, irritable colon, tongue edema, epigastric distress, gastroenteritis, increased transaminases, hemorrhoids, ileus, increased thirst, jaundice, melena, polydipsia, duodenal ulcer, stomach ulcer. **Endocrine System:** *Infrequent:* diabetes mellitus, goiter. **Hemic and Lymphatic System:** *Infrequent:* anemia, thrombocythemia, thrombocytopenia, eosinophilia, erythrocytopenia. **Metabolic and Nutritional Disorders:** *Frequent:* dehydration; *Infrequent:* gout, hypokalemia, increased creatine kinase, hyperglycemia, weight increase, increased lactate dehydrogenase. **Musculoskeletal System:** *Frequent:* bone fracture; *Infrequent:* muscle weakness, muscle fasciculation. **Nervous System:** *Frequent:* delusions, tremor, irritability, paresthesia, aggression, vertigo, ataxia, increased libido, restlessness, abnormal crying, nervousness, aphasia; *Infrequent:* cerebrovascular accident, intracranial hemorrhage, transient ischemic attack, emotional lability, neuralgia, coldness (localized), muscle spasm, dysphoria, gait abnormality, hypertonia, hypokinesia, neurodermatitis, numbness (localized), paranoia, dysarthria, dysphasia, hostility, decreased libido, melancholia, emotional withdrawal, nystagmus, pacing. **Respiratory System:** *Frequent:* dyspnea, sore throat, bronchitis; *Infrequent:* epistaxis, post nasal drip, pneumonia, hyperventilation, pulmonary congestion, wheezing, hypoxia, pharyngitis, pleurisy, pulmonary collapse, sleep apnea, snoring. **Skin and Appendages:** *Frequent:* pruritus, diaphoresis, urticaria; *Infrequent:* dermatitis, erythema, skin discoloration, hyperkeratosis, alopecia, fungal dermatitis, herpes zoster, hirsutism, skin striae, night sweats, skin ulcer. **Special Senses:** *Frequent:* cataract, eye irritation, vision blurred; *Infrequent:* dry eyes, glaucoma, earache, tinnitus, blepharitis, decreased hearing, retinal hemorrhage, otitis externa, otitis media, bad taste, conjunctival hemorrhage, ear buzzing, motion sickness, spots before eyes. **Urogenital System:** *Frequent:* urinary incontinence, nocturia; *Infrequent:* dysuria, hematuria, urinary urgency, metrorrhagia, cystitis, enuresis, prostate hypertrophy, pyelonephritis, inability to empty bladder, breast fibroadenosis, fibrocystic breast, mastitis, pyuria, renal failure, vaginitis. **Postintroduction Reports** Voluntary reports of adverse events temporally associated with ARICEPT® that have been received since market introduction that are not listed above, and that there is inadequate data to determine the causal relationship with the drug include the following: abdominal pain, agitation, cholecystitis, confusion, convulsions, hallucinations, heart block (all types), hemolytic anemia, hepatitis, hyponatremia, neuroleptic malignant syndrome, pancreatitis, and rash. **OVERDOSAGE Because strategies for the management of overdose are continually evolving, it is advisable to contact a Poison Control Center to determine the latest recommendations for the management of an overdose of any drug.** As in any case of overdose, general supportive measures should be utilized. Overdosage with cholinesterase inhibitors can result in cholinergic crisis characterized by severe nausea, vomiting, salivation, sweating, bradycardia, hypotension, respiratory depression, collapse and convulsions. Increasing muscle weakness is a possibility and may result in death if respiratory muscles are involved. Tertiary anticholinergics such as atropine may be used as an antidote for ARICEPT® overdosage. Intravenous atropine sulfate titrated to effect is recommended: an initial dose of 1.0 to 2.0 mg IV with subsequent doses based upon clinical response. Atypical responses in blood pressure and heart rate have been reported with other cholinomimetics when co-administered with quaternary anticholinergics such as glycopyrrolate. It is not known whether ARICEPT® and/or its metabolites can be removed by dialysis (hemodialysis, peritoneal dialysis, or hemofiltration). Dose-related signs of toxicity in animals included reduced spontaneous movement, prone position, staggering gait, lacrimation, clonic convulsions, depressed respiration, salivation, miosis, tremors, fasciculation and lower body surface temperature.

200176 Revised December 2000

Eisai Inc.
Teaneck, NJ 07666

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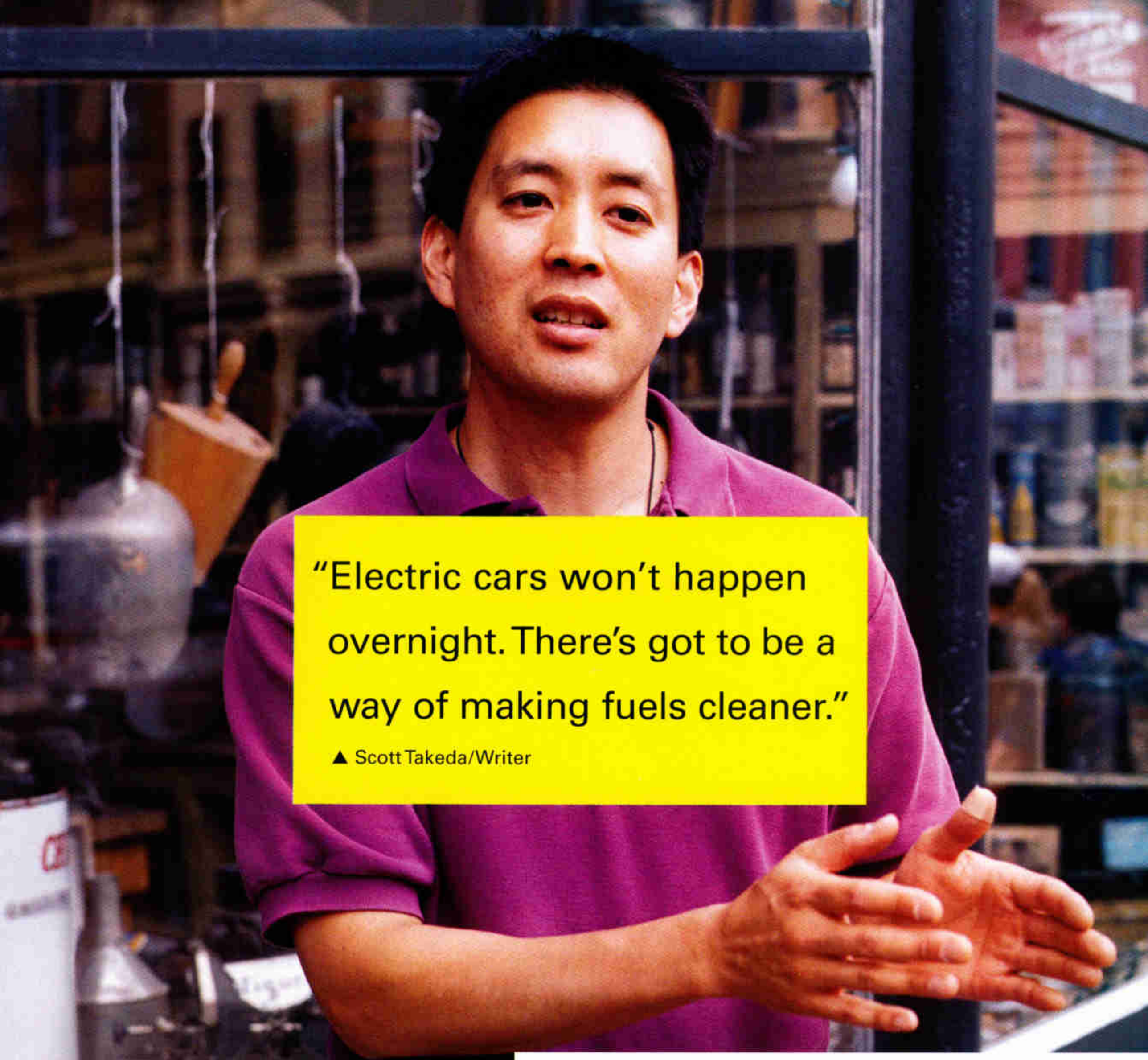

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Photographed by Nick Garbutt

WILDLIFE AS CANON SEES IT

Light filters through the forest canopy, highlighting the chestnut coat of a red ruffed lemur. These lemurs eat mainly fruit, notably figs, and small groups occupy a home range often located near the forest's largest fruiting trees. Females dominate and form the core of the group, while males have weaker social bonds. The female gives birth to a litter of up to five, but usually two or three. Unlike most other lemurs, who carry their newborns, she leaves her young in a nest while she forages. Red ruffed lemurs are threatened by forest destruction and, though legally protected, they are still hunted and trapped.

As a global corporation committed to social and environmental concerns, we join in worldwide efforts to promote greater awareness of endangered species for the benefit of future generations.

Red Ruffed Lemur
(Varecia variegata rubra)
Size: Head and body length, 50-55 cm; tail, 60-65 cm
Weight: 3 - 4.5 kg
Habitat: Rainforests of the Masoala Peninsula, northeast Madagascar
Surviving number: Population unknown; rare throughout its limited range

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Watch NATURE on PBS. This program is funded, in part, by Canon.

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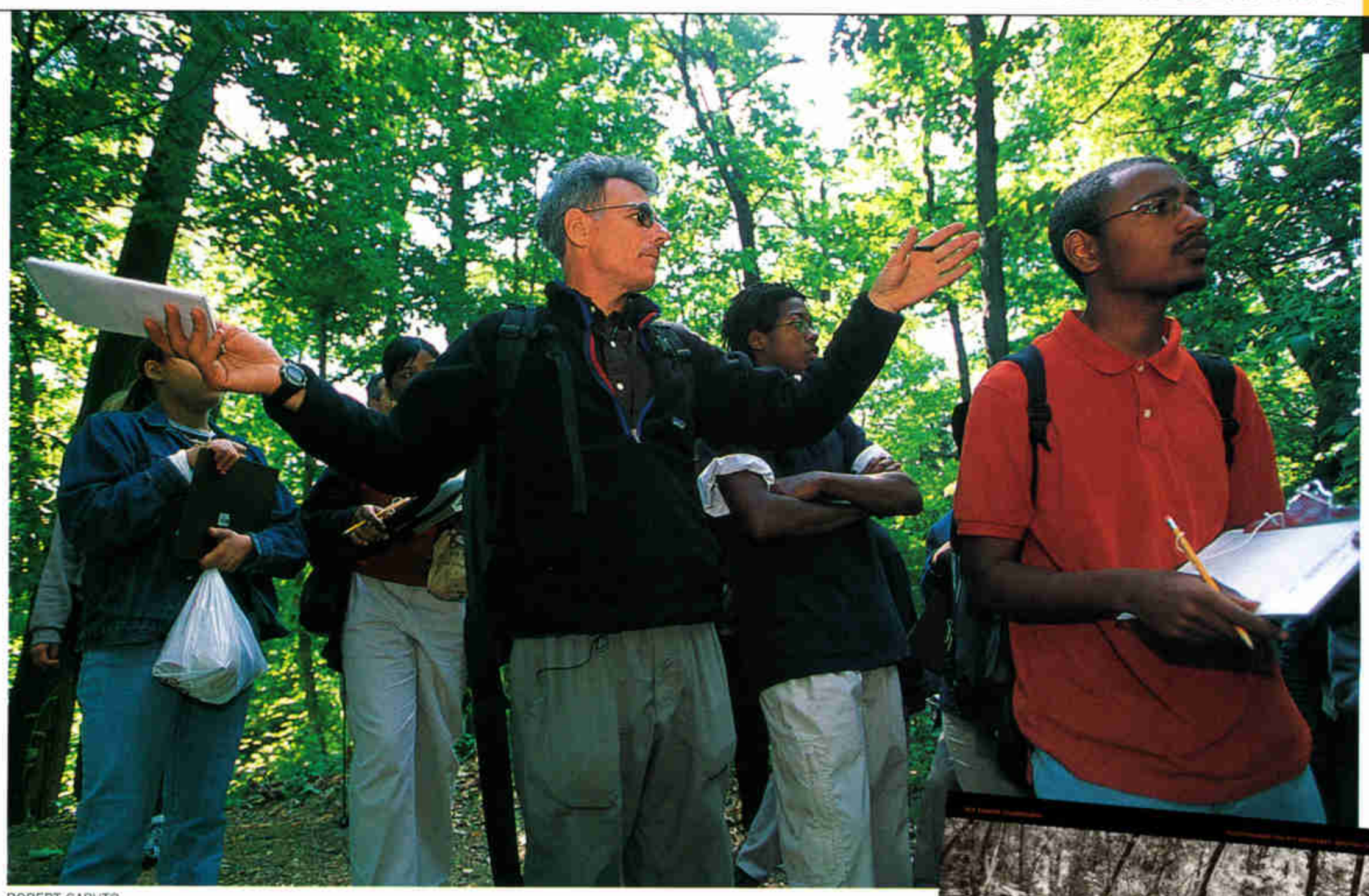

ROBERT CAPUTO

Call It a Minitransect

Nature study at home

They encountered no gorillas, they didn't have to wade across rivers, and the bugs were far more benign than those that bedeviled J. Michael Fay on the Megatransect, his 15-month, 2,000-mile trek across Africa (NGM, October 2000, March 2001, and August 2001). But these high school students (above, with Mike) from Washington, D.C., employed the same scientific method of record-it-all data collection in their walk through the capital's Rock Creek Park. In the process, they learned about their environment—and the effects humans have on it.

"They're city kids who don't spend too much time in the woods, and this crazy guy takes them out in the forest," says Mike. "I show them deer, black squirrels, the remains of Civil War forts, a fox den, and they become kids who start to think more seriously about nature and about the impact our society is having on the natural world."

ART BY JOHN CUNEO

Circulation Padding Department

Memo to Editor: Now we know where all those letters requesting articles about parasite grooming are coming from. After local schoolchildren donated boxes of NATIONAL GEOGRAPHICS to the Henry Vilas Zoo in Madison, Wisconsin, stories began to circulate that chimps had become avid readers of the magazine. Zoo staff reported that chimps seemed to be paying particular attention to the photos. It turns out that the zoo hides magazines, oranges, toys, and other stuff to encourage the chimps to forage as they would in the wild. "Bright colors attract them," says director Jim Hubing, "and the GEOGRAPHIC has beautiful pictures with bright colors. So they look at the magazines, and from time to time they focus on a picture."

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A Model Who's Only Skin-Deep

Silicone art imitates life

BOTH BY HYBRID ENTERPRISES (UK)

That's British model Cassandra Wheatley on this month's cover—her hands, that is, holding a lifelike silicone copy of her face. Wheatley sat in a chair for 40 minutes in Leeds, England, as technicians at Hybrid Enterprises, who normally do such things to create dummy heads or body doubles for films, made a "life mask" of her face by painting silicone molding material on it and covering it with wet plaster. All the while, Wheatley sat up and breathed normally through her nostrils. "It feels heavy, because you're not used to having things on your face," says Mike Stringer, Hybrid's technical director, "but it really isn't heavy. It's quite comfy—as long as you're not claustrophobic."

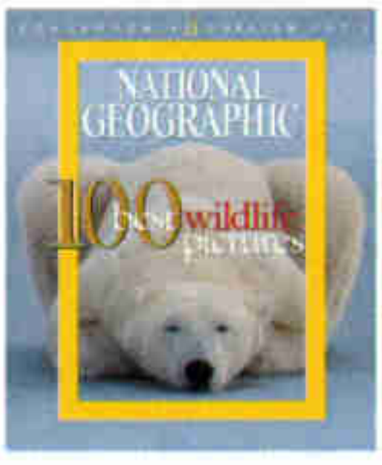
The team made successively more detailed casts, touched up air bubbles (above), and made a flexible mold over one of the casts. They then separated the two surfaces and injected liquid flesh-toned silicone between them. When they peeled the flexible mold away (left), they were left with the final mask, into which they punched eyelashes and eyebrows with a hypodermic needle.

Wheatley flew to the U.S. for the photo shoot. The mask, a mere five-eighths of an inch thick, now rests in the office of Kurt Mutchler, the illustrations editor for this month's story on skin.

100 Best Wildlife Pictures

FRANS LANTING

Frans Lanting sailed icy storm-tossed seas to get to Albatross Island in the South Atlantic, then crept within feet of two amorous wandering albatrosses to take this photograph (right), moving his camera in time with the male's dance so he wouldn't disturb them.



"Our photographers go where the wildlife is," says illustrations editor Kathy Moran. "They'll endure any hardship to find animals, to hunt them with a camera."

The *100 Best Wildlife Pictures*, a large-format special issue, goes on sale on newsstands and in bookstores November 1. You can order this celebration of wildlife photography at National Geographic at *nationalgeographic.com/ngm/bestwildlife*, or call 1-800-777-2800 (toll free in the U.S. and Canada). Elsewhere call 1-813-979-6845. An exhibit based on this special issue will be on display in the Society's Explorers Hall through January.

FOR MORE INFORMATION

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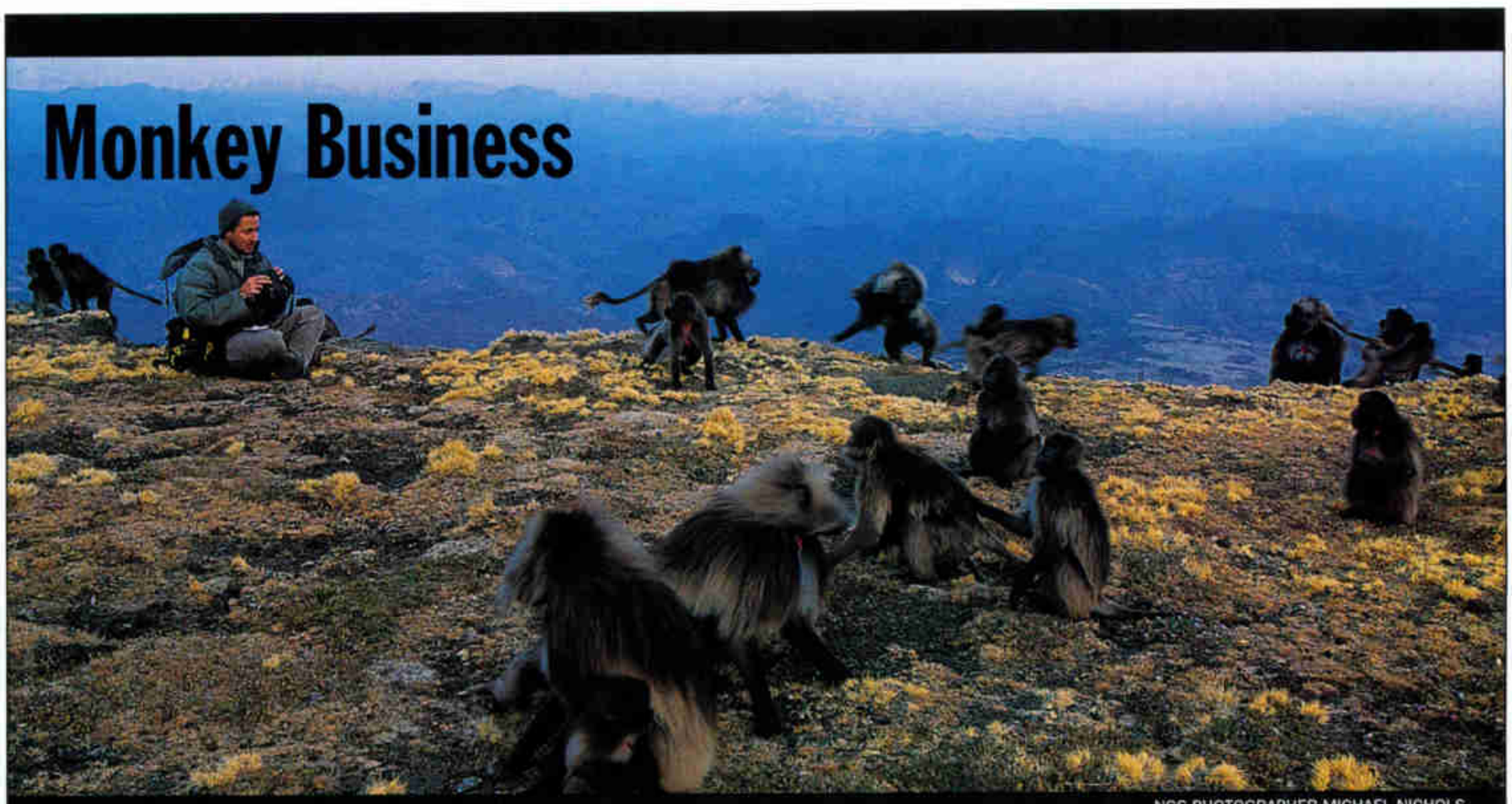

NGS PHOTOGRAPHER MICHAEL NICHOLS

Biologist Chadden Hunter watches a noisy gang of geladas rise at dawn in the Ethiopian highlands. "It's loud out there," says photographer Michael Nichols. Hear their chatter and see them in action as Nichols describes their unique female-dominated society at *nationalgeographic.com/ngm/0211*.

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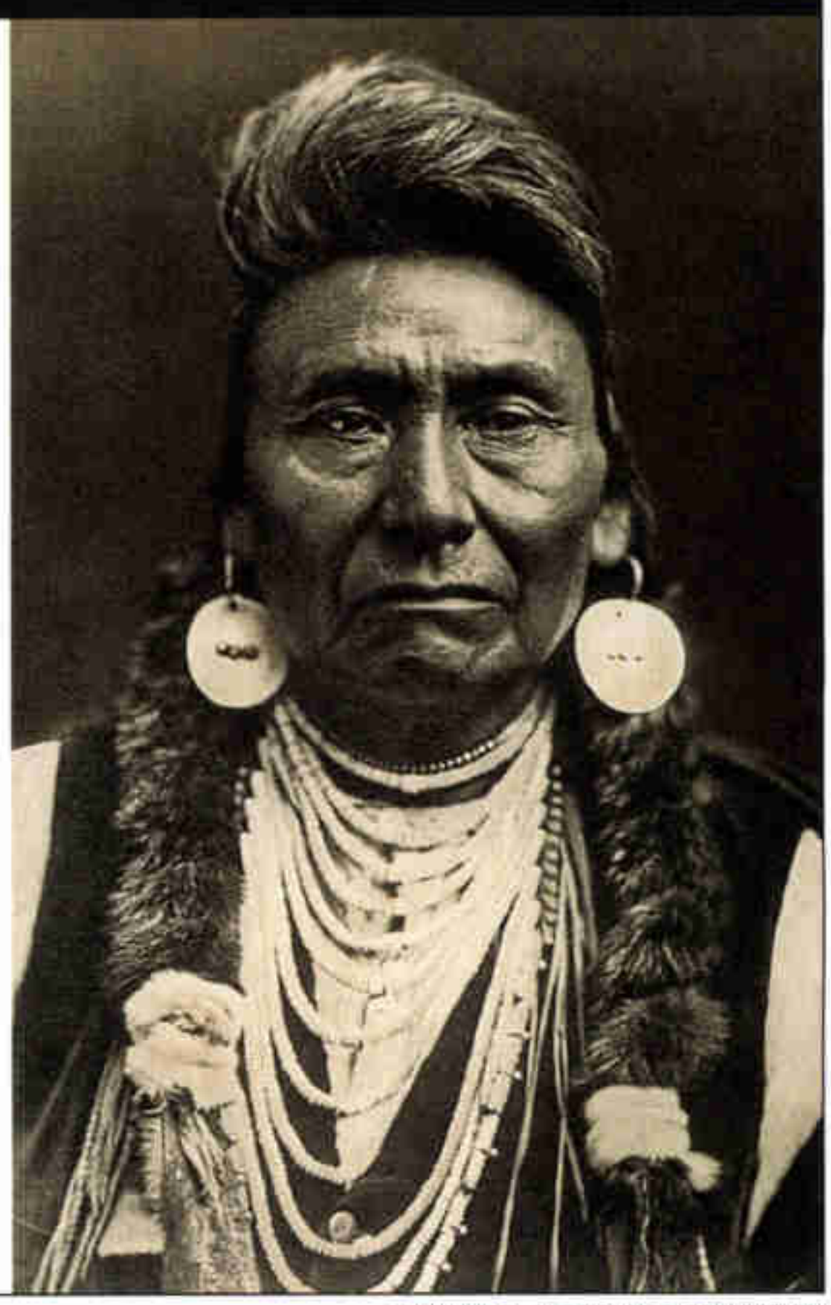
Lewis and Clark

President Jefferson sent Lewis and Clark west expecting that they might find mammoths and volcanoes, but what they actually saw was no less amazing: some 300 new species, 47 Indian tribes (including the Nez Perce of Chief Joseph, right), and the Rocky Mountains. Relive their discoveries, see how the land has changed, and post your own trail stories at *nationalgeographic.com/lewisandclark*.



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NGS PHOTOGRAPHER JODI COBB

NATIONAL GEOGRAPHIC SPECIAL, PBS, NOV. 13

Skin

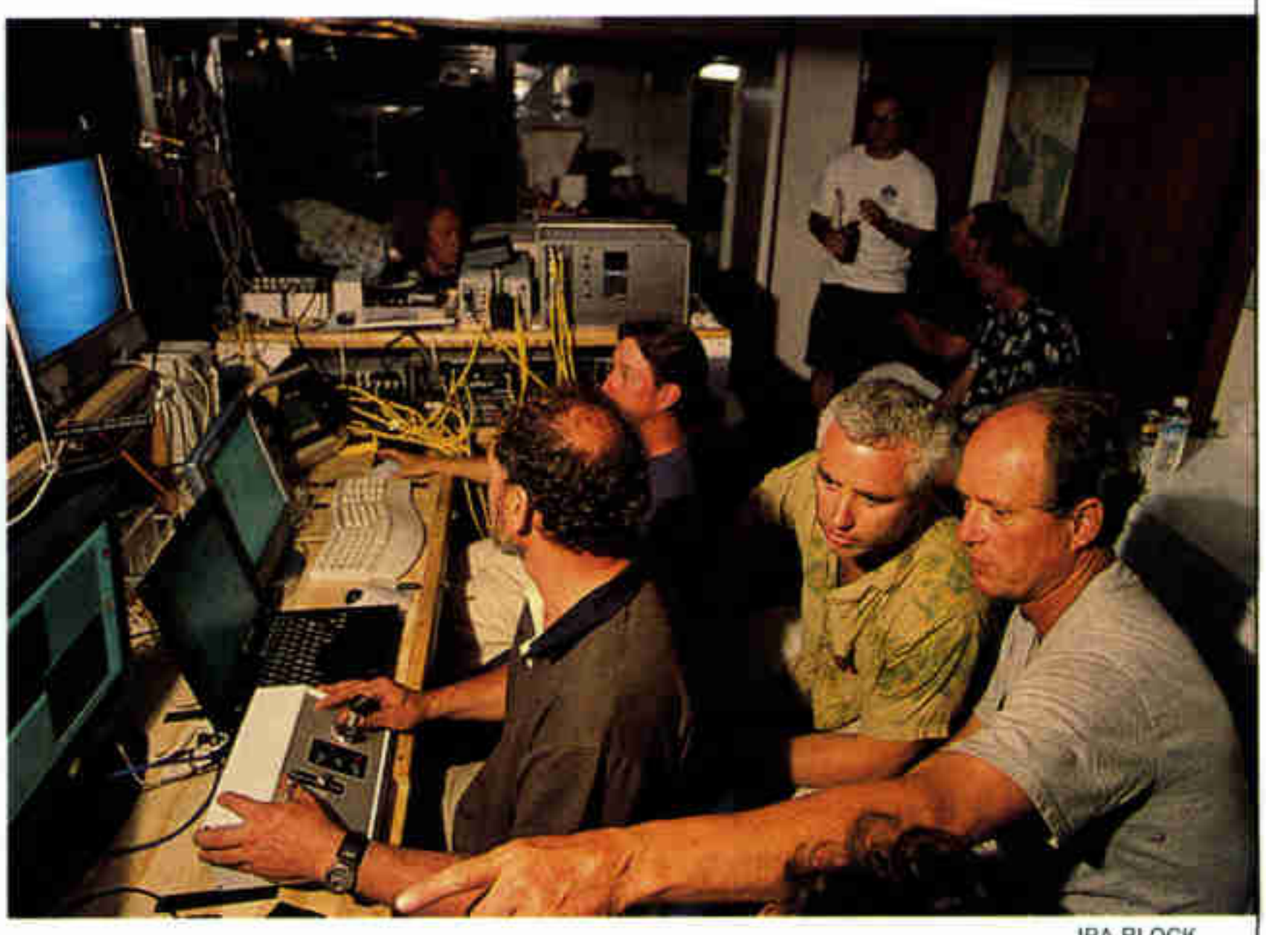
Its color can cause irrational fear, and its markings—like a woman's scars in Ethiopia (left)—can encode unique cultural meanings. *Skin*, a one-hour Special, takes an intimate look at the organ that protects and exposes. From fashion models to tattooed toughs, skin tells revealing stories. And why is touch the best medicine? At a Miami hospital elders caress premature babies to enhance the health of young and old alike.

NATIONAL GEOGRAPHIC CHANNEL

What's Taboo?

DAVID EVANS

Summoning voodoo spirits (above), changing one's gender, tripping on hallucinogenic peyote: You aren't supposed to *do* that, are you? All cultures separate good from bad—they just draw the boundary in different places. Cross the boundary with this new weekly series on the world of taboo.



IRA BLOCK

NATIONAL GEOGRAPHIC EXPLORER
MSNBC, NOVEMBER 24

Search for PT 109

Young Lt. John F. Kennedy became a hero in August 1943 when his patrol boat, *PT 109*, was rammed by a Japanese destroyer in the Solomon Islands. Join Robert Ballard (above, at right) in the tense hunt for the long-lost wreck.

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Who Knew?

THE EASTERN FOREST

Wood Tales

Trees just won't stand still

Can the eastern forest become what it used to be? Four centuries ago a great, dark, foreboding forest—a "howling wilderness" as the pioneers called it—stretched across more than 650 million acres of eastern North America.

The settlers looked at the forest and saw boards, shingles, the masts of ships. They saw fuel, with farmland underneath. Their axes got busy.

A few uncut patches remain, such as Cathedral State Park in West Virginia. Nothing much seems to have changed there in 400 years, except for the addition of rest rooms and playground equipment (today the definition of "wilderness" is a place without a gift shop).

But most of the ancient forest is gone. Even before Europeans arrived, Indians had burned much of it to open the understory for hunting. The strange thing is, the tree cover of the East is actually more extensive now than it was decades ago. Look at Civil War pictures, and you'll see denuded landscapes; some of those places are now so heavily wooded you can't see the trees for the forest. Why? Economics: Much of the new forest is abandoned farmland. Conservation also made a difference.

So will the new eastern forest completely return to its former self? Nice thought, but forests aren't like that. They're always in flux. There was no "way it was."

In 1995 Emily Russell, an ecologist at Rutgers University, floated in a canoe on Green Pond in Morris County, New Jersey, and dispatched a scuba diver to the bottom. The diver collected a sediment core using a narrow tube. In her lab Russell applied acids to the sediment, dissolving everything except hard, resilient, microscopic grains of ancient pollen.

By analyzing this and 55 other sediment cores from around the Northeast, she and colleague Ronald Davis discovered that the beech—a species hit by a fungus in the 20th century—was in decline long before Europeans showed up.

Her research supports a new paradigm: Forests are a "shifting mosaic." You may know the term "climax forest," denoting woods that have reached their final, mature, balanced, serene condition. That's a fairy tale forest; the real forest is always being disturbed by something.

Forests never reach equilibrium, points out Brian Donahue, an environmental historian at Brandeis. With the retreat of the glaciers at the end of the last ice age, different types of trees began migrating over the landscape.

They're still shifty. Opportunistic red maple and birch are popping up in forest clearings everywhere. But hemlock is in decline, sapped by an aphid-like insect. The chestnut is almost gone, blasted by an invasive fungus. And global warming is the wild card—it could drive trees north at an accelerated rate.

What's certain is that the eastern forest's future will be different from its past. "It's a lesson for conservation," Russell says. "We want to reestablish native species, and we want a forest that's regenerating and healthy—but it's never going to be static." Because trees aren't just a bunch of stiffs.

—Joel Achenbach
WASHINGTON POST STAFF WRITER

IT MATTERS

The part of a tree you don't see is at least as important as the part you do.

The roots of a giant sequoia may reach across nearly three acres of forest floor. Even a modest suburban honey locust can spread roots over more than a thousand square feet of backyard. It matters that we show roots a little respect. If logging or wildfire destroys trees on steep slopes, soil-holding roots decay and landslide risk increases dramatically. Trees reduce shoreline erosion—and the need for costly bulkheads. Levees with trees often hold back floodwaters better than levees without. Trees give us shade, 2x4s, and prime spots for squirrel-watching. But look at trees like an engineer, and you'll see living girders that help stop hillsides from slumping across highways and keep your favorite trout stream running clear.

—Lynne Warren

MORE ON OUR WEBSITE

Learn more about the changing understanding of the nature of forests—and find links to Joel Achenbach's work—at **nationalgeographic.com/ngm/resources/0211.**

CARY WOLINSKY

Weapons of Mass Destruction

An ominous new chapter opens on the twentieth century's ugliest legacy

BY LEWIS M. SIMONS
PHOTOGRAPHS BY LYNN JOHNSON

TEST OF TIME It's been half a century since the Soviets set off their first nuclear bomb here on the Kazakh steppe, and 13 years since the last test. So the arms race may seem like a scrapbook memory in the test-blast photos of a security officer at the site. But it's not: The weapons it spawned left a trail of ruin, and their menace is as real as ever.

SCHOOLED IN FEAR Second graders in the town of Shchuchye, Russia, learn about their next-door neighbor: one of the world's largest chemical weapons depots, two million shells and warheads loaded with choking agents and nerve gas. Few families in town have gas masks, so if there's an accident the children are taught to cover their faces with scarves.

"FRIGHTENINGLY EASY" That's how simple it was for a Pentagon team to build this makeshift anthrax lab inside the Nevada Test Site, according to one participant. Buying equipment from hardware stores and lab-supply outfits, the team took just over a year to produce simulated anthrax. The project was designed to identify detectable patterns of activity of a terrorist lab and to see if law enforcement officials would notice. They didn't.

ROBB KENDRICK

You may have missed this:

A month or so before Christmas, three people, most likely male, walked into a crowded shopping mall in Oklahoma City. Dressed as maintenance workers and carrying plant sprayers, they strolled among the holiday shoppers, tending to the potted plants that decorated the gaily lit corridors. A short time later, their work complete, the three walked to mall exits and vanished into the night. At that moment two other teams were doing the same thing at malls in Atlanta and Philadelphia.

At 7 p.m. on December 9, the President of the United States met secretly with his National Security Council—which included the national security advisor, the secretary of defense, and the chairman of the joint chiefs of staff. The President stunned them with his opening remarks: "The Centers for Disease Control (CDC) has confirmed that at least one case of smallpox—and maybe as many as 20—have occurred among civilians in Oklahoma City. . . . Presumably, this disease has been deliberately introduced and [is] the result of a bioterrorist attack on the United States." As the President spoke, a laboratory in Oklahoma confirmed 20 cases of smallpox and said it suspected 14 more. Nine other cases were reported in Atlanta and seven in Philadelphia.

COLD WAR LEFTOVERS **A decade after the demise of the Soviet Union and its immense bioweapons industry, vials of plague germs are still kept in an old pea can at a biological institute in Kazakhstan. Until recently the facility had little security. Alarmed by the vulnerability of such sites, the United States has stepped up funding to help secure them. In contrast, security is airtight at the Department of Energy's Pantex Plant in Texas (left), where thousands of nuclear warheads have been dismantled.**

Federal and state authorities immediately swung into action, and within 24 hours FBI agents were combing the streets of Oklahoma City. At the White House, the deputy secretary of health and human services confirmed that the only two known sources of smallpox were at the CDC's heavily guarded repository in Atlanta and the Vector laboratory outside Novosibirsk, Russia. Intelligence revealed that a former Vector scientist, an expert in smallpox, had left Russia and was believed to be in Iraq.

By the next week, tens of thousands of Americans showing symptoms, or imagining them, were overwhelming hospital emergency rooms. Television news repeatedly ran footage of a tearful mother, toddler in arms, pleading for vaccine as a policeman shoved her back into the crowd.

Meanwhile, chaos swamped those who were trying to manage the crisis. Congress and state legislatures, the FBI and CIA, fire and police departments, the Defense Department and National Guard, public health agencies and private physicians—all lost valuable time and energy in the confusion over procedures and turf.

By December 15, officials had confirmed 2,000 cases in 15 states, with more in Canada, Mexico, and Britain. The death toll had hit 300.

A week later there were 16,000 cases in half the states in the country, and a thousand people had died—200 from reactions to vaccine. Cities were paralyzed as millions tried to flee the epidemic. Vaccine supplies were now exhausted, and violence was rampant in the streets.

Health authorities projected that by February there would be three million cases of smallpox in the United States. One million Americans would be dead, with no end in sight.

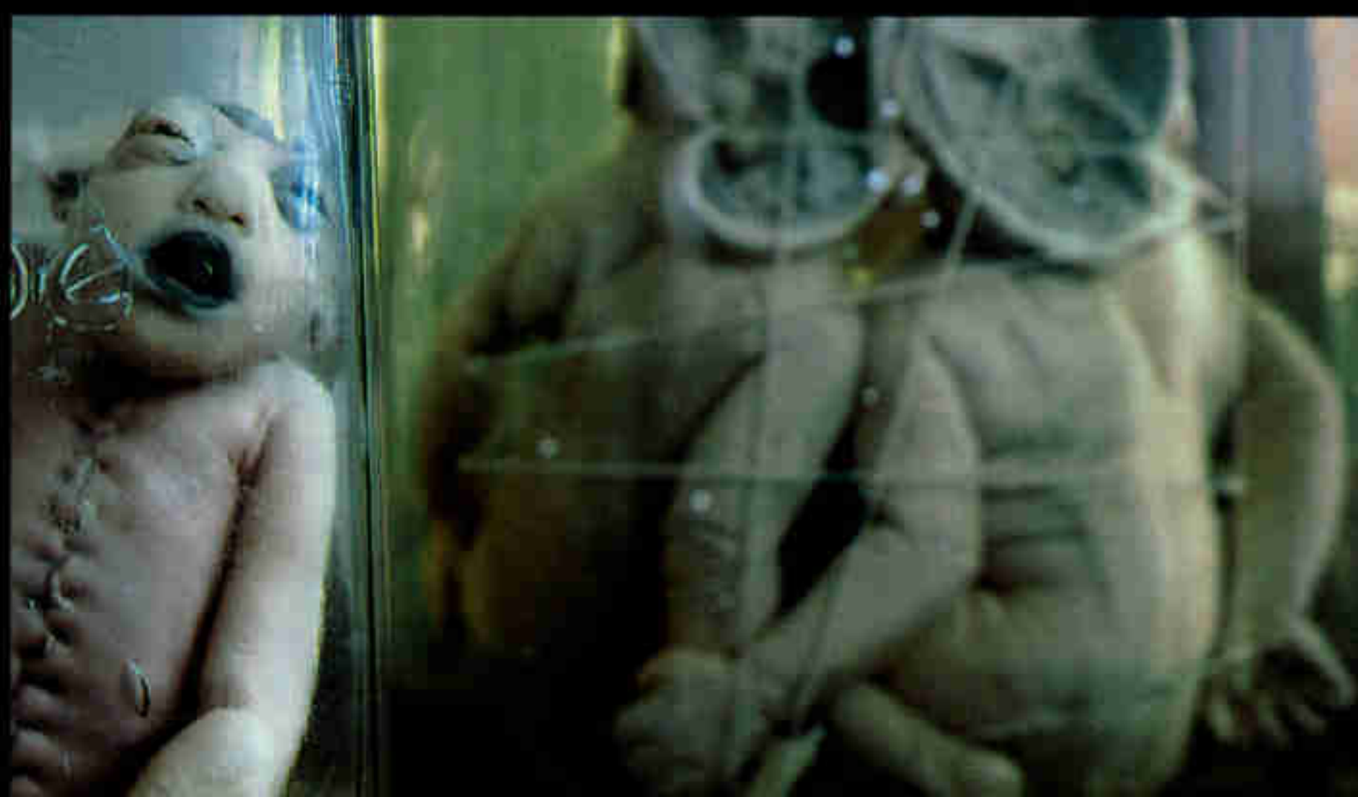
GAME OVER.

This doomsday scenario was, in fact, a game, but no one involved was having any fun. It was played in June 2001 *(Continued on page 14)*

The Human Toll

NUCLEAR PIONEERS "I was trying to come to terms with something that always seemed ugly and terrifying," says poet Judith Vollmer of her sojourn at the Nevada Test Site (above). Vollmer's father, who died last year, worked 30 years in the nuclear industry and to him, she says, "It was thrilling. It was going to be a source of wealth and plenty." In 1962 this crater was carved by a nuclear blast seven times the size of Hiroshima's, part of a program testing the use of nuclear explosives to build harbors, tunnels, and canals. "The men of his generation were courageous and inventive as well as reckless and unknowing. There was a blind innocence in it." **DOWNWINDER** Dave Timothy (facing page, top) lost his innocence early. He grew up on a farm in Utah, downwind from the Nevada Test Site. "One day I was out cutting hay, and there was this bluish gray haze in the air. The sweat on my arms and face felt like stinging nettles, and I had to take a rag and keep wiping off, because it burned so bad. By the time I was 18, I had thyroid cancer." His neck scarred from a series of operations, he's lucky to have survived the past 35 years. Fallout from tests has been, or will be, responsible for 17,000 cancer deaths in the U.S. **MUTED LIVES** At a medical institute in Kazakhstan, fetuses deformed by fallout tell more than statistics ever will: Nuclear testing has left a grievous legacy—for those who survive, and those who never got a chance to.

"I have medical bills there's no way you could ever pay, and every time life gets going, here comes cancer again." *—Dave Timothy*



"To this day, no one has ever told us that anthrax killed him. They gave us 40 rubles, and I used it to buy a dress for the funeral."

—Olga Vyatkina

The Human Toll

KILLING ROOM "They make it look so clean," says Yoshio Shinozuka, holding a photo of a model of the torture chamber where he once worked (left). "It was dirty and dark and bloody." Only 16 when he was sent to Japan's infamous Unit 731 in World War II, Shinozuka helped doctors study the effects of diseases like anthrax and plague on prisoners in occupied China. Often they dissected their victims—"logs," they called them—while still alive, without anesthesia. The Japanese killed perhaps 10,000 people here, and another 250,000 throughout China with biological weapons, including plague. After the war the U.S. government gave Unit 731 scientists amnesty in exchange for their trove of data. **EYEWITNESS** Hiroto Kuboura (below) knows all too well that there are no good guys in this game. He lost his left eye in the Hiroshima atomic blast, which with the Nagasaki blast killed more than 120,000 Japanese. "I kept asking myself what I could have done to deserve this agony," he wrote in his account for the Hiroshima museum. Of course there was no answer. **BIO-CHORNOBYL** Olga Vyatkina never got an answer either. The Soviet authorities said it was "bad meat" that killed her son and at least 67 other people in Sverdlovsk back in 1979, but people knew better—you don't wear protective suits to treat victims of food poisoning. The city's bioweapons plant had accidentally released a plume of anthrax spores, causing the worst outbreak of inhalational anthrax ever recorded.

around a table at Andrews Air Force Base, outside Washington, D.C. Former U.S. Senator Sam Nunn assumed the role of the President, with other prominent figures playing cabinet members, military leaders, heads of federal agencies, state officials, and journalists. The point of the exercise, code-named Dark Winter, was to see how prepared the United States was to deal with a biological weapons attack.

So how did it go? Soon after the exercise Nunn testified before the U.S. Congress—the real one—on the failures Dark Winter had exposed. The country was critically short of vaccine, Nunn warned. It had not trained top officials, planned a coordinated response, built an adequate public health infrastructure, educated the public or the media, practiced the few plans that were in place, or ranked bioterror as a high national priority. "It's a lucky thing for the United States," said Nunn, "that this was just a test and not a real emergency."

It took a real emergency—September 11 and its aftermath—to turn this exercise from a grim fantasy to a matter of life and death.

Although the airplane attacks on the World Trade Center and the Pentagon showed that almost anything could be used to kill large numbers of people, most of us probably still visualize the nuclear blast, with its signature mushroom cloud, when we think of weapons of mass destruction, or WMD, as national security experts know the genre.

But while some countries are amassing bombs and a few more are working feverishly to acquire their first, the world may have more to fear from other, less familiar means of attack. At one end of the scale are alternative threats ranging from so-called dirty bombs—conventional explosives wrapped in radioactive material—to the click of a cyberterrorist's mouse, hacking into computer systems to attack a nation's water supply, air traffic, energy infrastructure, financial systems, and communications. At the other end, the most lethal attacks would be caused by traditional nuclear, chemical, and biological weapons.

Around the time that "President" Nunn was grappling with Dark Winter, photographer Lynn Johnson and I set out to report on the threats facing humanity from such weapons. In the many months since, we've traveled to some of the world's darkest and most frightening corners, in Russia, Kazakhstan, Ukraine, Iran, Japan, and the United States.

At first we found people barely paying attention, hardly aware that such threats existed. Then came September 11, followed by the discovery of anthrax spores in letters to U.S. politicians and media figures. The sobering lessons of Dark Winter rose to the top of everyone's agenda. Governments scrambled to prepare for, and prevent, the next attack.

In response to these disasters, Lynn and I naively expected that locked gates would be thrown open to us and the searchlights switched on. Instead we found that blackest night had fallen on the tightly guarded world of WMD. Doors were slammed in our faces. Key scientific labs and military installations around the world that had given us the green light before September 11 were suddenly off-limits. Political leaders clammed up. Intelligence agents had better things to do. People we had trusted dealt us lies and misinformation.

Still, we managed to pry open enough doors to gain a clear sense of what humanity is facing in this battle for our collective future. Because of its status as the world's only superpower, the United States is the most obvious target, but the whole world is now on notice: When nations—or terrorists—turn to weapons of mass destruction, no one on Earth is truly safe.

All this comes at a time when the old geopolitical rules seem to have flown out the window. For half a century a titanic clash of superpowers kept nations divided but fairly certain of who had the power to do what and to whom. No more. In many ways the world is more dangerous today than at any time since 1945, when the United States first used a

TRAGIC FALLOUT **"They didn't say anything about radiation," says Ludmila Shakhvorostova, recalling the nuclear tests she watched as a young woman in Dolon, Kazakhstan. The Soviets set off hundreds of blasts at a site just 60 miles upwind, but a map tracing fallout patterns (left) was kept secret. Now 80 percent of the 1.5 million people in the region have weakened immune systems, and cancer and birth defects are rampant. Ludmila's two sons, born in the 1950s, are profoundly retarded.**

nuclear weapon to bomb Japan into submission and end World War II.

"There is no longer a [single] global conflict," Zinovy Pak, director of the Russian Munitions Agency, told me in Moscow. "But is the world safer? Unfortunately not. Today there are mainly local causes of conflict—social, religious, ethnic, racial. But because of developments in science and technology, there are new ways, new weapons, to resolve these conflicts."

A dozen years after the Cold War finally petered out, the United States and Russia still control most of the world's WMD. Each has enough weaponry to kill every form of life on Earth many times over, if dying more than once were possible.

In the latest round of nuclear arms cuts, Presidents George W. Bush and Vladimir Putin agreed to reduce the number of warheads mounted on missiles and bombers from their current levels of around 6,000 each to no more than 2,200 each by the end of 2012. Few experts believe that either nation would set out to use these weapons against each other—unlike some other members of the WMD club.

In the Middle East it is widely believed that Israel possesses all three categories of WMD, with its enemies Iraq and Iran not far behind. Libya, Syria, and Egypt are involved in chemical and biological programs (see pages 18-19).

South Asia vies with the Middle East as the world's most volatile danger zone. India and Pakistan, who've been staring down the barrel at each other across the lovely and bitterly contested region of Kashmir, are both armed with nuclear weapons. They've fought three conventional wars and narrowly averted another earlier this year. Certainly the next one, or the one after that, could go nuclear.

Elsewhere, North Korea and China are known to possess, or to be developing, one or more types of WMD. And in Europe, France and the United Kingdom bear nuclear arms.

Then there are the freelancers, what the analysts call "non-state actors" (though some are funded and housed by governments), whose willingness to die for their beliefs makes their tactics and their timing utterly unpredictable. If they were to strike, where would they get their weapons?

Russia, because of its vast WMD stocks and economic turmoil, is the most obvious answer. A poor and weak Russia can cause harm in ways that a powerful Soviet Union never did—even as it is voluntarily disarming.

Given Russia's dysfunctional economy, Moscow is in no position to spend millions of dollars on security for its stores of deactivated nuclear warheads, along with the former U.S.S.R.'s decaying production facilities, submarines, and reactors, which hold enough material for thousands of nuclear bombs.

Russian authorities say that since 1991, there have been 23 attempts to steal fissile material from nuclear facilities and Soviet-era stockpiles, which reside at over 40 locations across Russia as well as in former Soviet republics. In 1994 the U.S. government purchased 1,300 pounds of highly enriched uranium from Kazakhstan to get it out of circulation.

Some of the thieves were caught. Others succeeded in smuggling small quantities of weapons-grade material out of the country, leading U.S. intelligence officials to speculate that enough material for a nuclear bomb has already left Russia. Also of grave concern are the unknown quantities that went missing or unaccounted for as the Soviet bureaucracy unraveled.

The U.S. Defense Threat Reduction Agency (DTRA) and the Department of Energy have launched programs to dispose of such material and to update security at former Soviet facilities, and U.S. lawmakers recently increased funding for their efforts. But even with U.S.-supplied razor wire and TV monitors, Russian WMD sites are subject to the whims of underpaid scientists and soldiers who have been stripped of their former prestige and dignity.

The Twentieth Century's Deadly Yield

It has been called the century of the atom, but the atom had company. Toxic chemicals and diseases, used in war since ancient times, were made into powerful new weapons—and the world has struggled to keep them in check.

PUBLIC RECORDS OFFICE, LONDON

Casualties of German chlorine gas attack, France, 1915

1899
Two dozen countries sign Hague Convention, pledging not to use toxic gases or other poisons as weapons.

1914-18
Chemical weapons used on World War I battlefields. Germany attacks with chlorine gas; Allies retaliate. By war's end gases cause 1.3 million injuries and 100,000 deaths.

1925
Geneva Protocol bans the use of chemical and biological weapons in war.

1936
German scientists discover the nerve agent tabun—far deadlier than anything used in World War I.

1932-1945
Japan kills 260,000 in China with biological weapons, chiefly plague.

1942
The Manhattan Project begins. Its object: the first nuclear weapon.

1945
U.S. drops first atomic bombs on Hiroshima and Nagasaki, killing more than 120,000.

1949
U.S.S.R. tests its first nuclear weapon.

Nuclear blast at Nevada Test Site, 1952

LOS ALAMOS NATIONAL LABORATORY

1950s-1960s
U.S. identifies dozens of viral and bacterial agents that can be weaponized. Testing done on animals and humans.

1952
United Kingdom tests its first nuclear weapon.

While the world puts Russia under the microscope, it's hardly the only source of tools for terrorists. In the United States, as well as in other advanced nations, chemical plants, biological labs, food irradiation plants, medical x-ray facilities, and nuclear reactors and waste repositories are all potential suppliers.

In 1998 three Greenpeace activists boarded a British-flagged freighter carrying a cargo of highly radioactive nuclear waste as it approached the Panama Canal en route to Japan. Greenpeace meant to protest the environmental hazards of shipping nuclear materials, but it amply demonstrated how easily terrorists could hijack such deadly cargo.

International treaties designed to exercise at least some limited control over WMD have been in place for decades, with varying degrees of effectiveness. (Citing those failures, the Bush Administration has pulled the United States out of international nuclear agreements and criticized existing biological and chemical treaties, to the consternation of its allies.)

Russian munitions chief Pak's specific task, under the Chemical Weapons Convention, is to destroy 44,000 tons of Soviet chemical agents. He notes that both Russia and the U.S. are already years behind schedule on meeting the 2007 deadline imposed by the convention for destroying chemical stockpiles.

Some experts are skeptical about the potency of chemical weapons, which can be rendered ineffective by heavy wind or rain. But don't tell that to the Iranian war veterans I talked to, whose health was ruined by Saddam Hussein's poison gas attacks in the 1980s, or to the Kurdish villagers I interviewed who watched their families die agonizing deaths in similar attacks. And don't tell it to Yoshiyuki Kouno, whose wife, Sumiko, has been in a vegetative state since she inhaled sarin gas released by the Aum Shinrikyo cult near her home in Matsumoto, Japan (pages 32-3).

Although Zinovy Pak's days are spent dealing with chemical weapons, his "worst nightmare"

1960
France tests its first nuclear weapon.

1962
Cuban missile crisis brings world to brink of nuclear war.

1963
U.S., U.K., and U.S.S.R. sign treaty ending above-ground nuclear tests.

1964
China tests its first nuclear weapon.

1968
59 nonnuclear nations join U.S., U.K., and U.S.S.R. in nuclear Nonproliferation Treaty (NPT). Today's total: 187 nations.

1972
U.S., U.S.S.R., and more than 100 other nations sign Biological Weapons Convention. U.S. continues defensive research; Soviets violate pact.

U.S. and U.S.S.R. sign Anti-Ballistic Missile (ABM) Treaty.

DIMITRY BELIAKOV

Dismantled warhead cover, Russia, 2000

1974
India (not party to NPT) tests its first nuclear weapon.

1979
Anthrax spores accidentally released in U.S.S.R. kill at least 68 people.

1980
Smallpox is officially eradicated.

1983-88
Chemical weapons used extensively in Iran-Iraq war; thousands die.

1988
Iraq kills 5,000 Kurds with mustard gas and other chemicals dropped on the town of Halabjah.

1991
UN orders Iraq to destroy all weapons and related technology, then begins inspections.

Soviet Union dissolves; U.S. starts nonproliferation aid program in former U.S.S.R.

1992
U.S. announces moratorium on nuclear tests.

1993
Chemical Weapons Convention opens for signature.

1995
Religious cult releases sarin nerve gas in Tokyo subway, killing 12.

1996
All Soviet nuclear weapons in Belarus, Kazakhstan, and Ukraine are transferred to Russia.

1998
Pakistan tests its first nuclear weapon.

Citing lack of cooperation, UN withdraws weapons inspectors from Iraq.

Rockets loaded with sarin nerve gas, Iraq, 1992

UNSCOM; FBI (BELOW)

2001
Al Qaeda attacks World Trade Center, Pentagon.

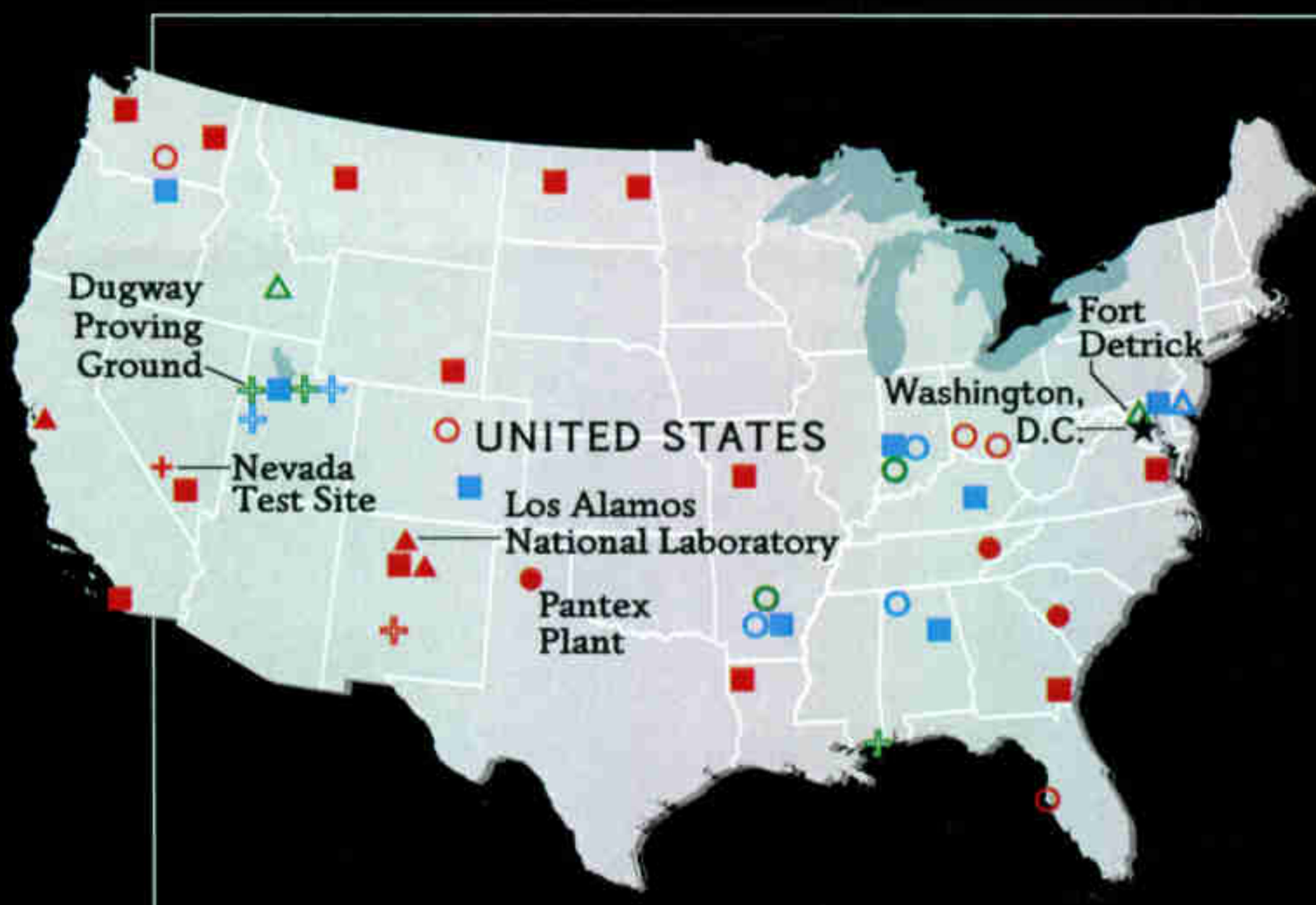
Anthrax spores mailed via U.S. postal system infect 23, killing five.

2002
U.S. withdraws from ABM Treaty to allow development of missile defense.

Anthrax-laced letter, Fort Detrick, Maryland, 2001

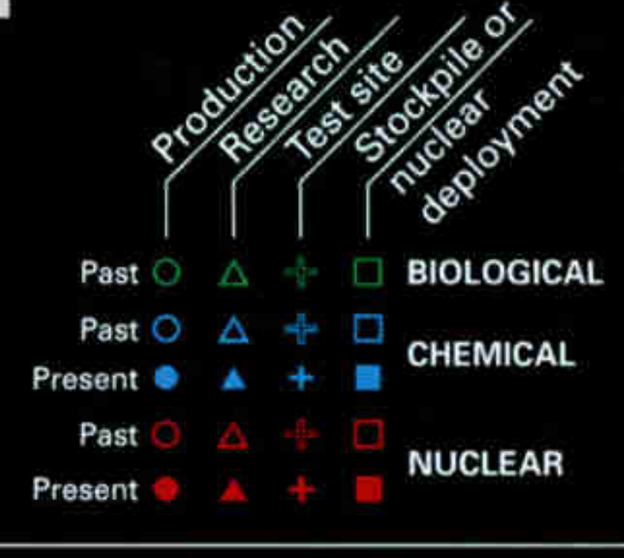
Taking Stock of Pandora's Box

The good news: By volume, weapons of mass destruction (WMD) are on the decline. U.S. and Russian nuclear stockpiles are far below Cold War levels, and recent accords will lower them further. The U.S. eliminated its biological stockpile in the early 1970s and Russia claims to have done so in the late 1980s. Both countries have agreed to destroy their chemical stockpiles by 2007. The bad news: It's very difficult to control the spread of weapons, materials, and expertise. Several nations have growing programs, and experts fear that potential terrorist weapons such as portable nuclear "suitcase" bombs and smallpox have not been adequately secured.



Weapons Facilities, Past and Present

Scores of shuttered weapons facilities dot the U.S. and former U.S.S.R. The U.S. has spent five billion dollars to help Russia dismantle facilities and weapons, but much work remains. Security at many sites is poor, and thousands of people with valuable—and dangerous—technical expertise have lost their jobs.



UNITED STATES

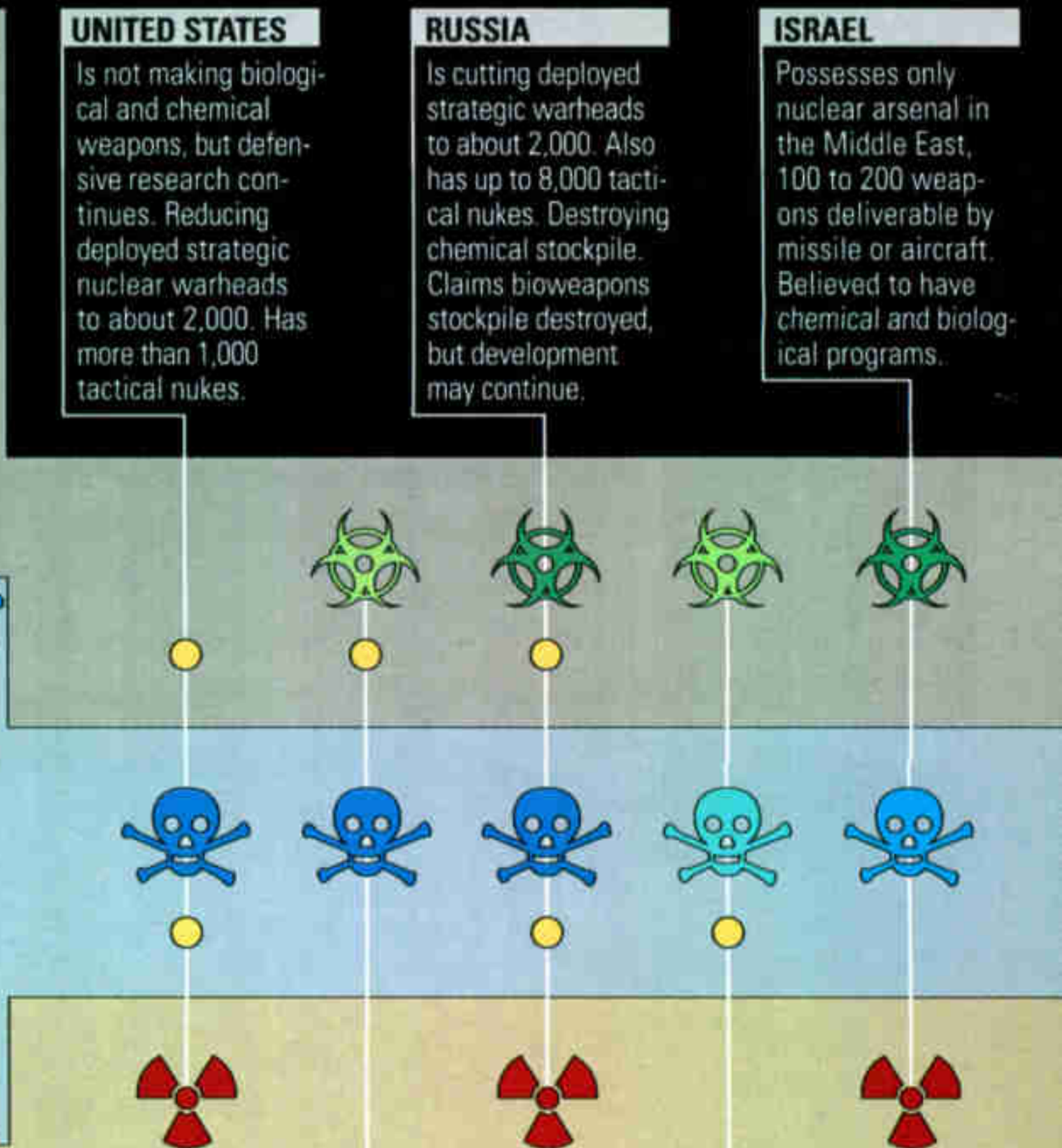
Is not making biological and chemical weapons, but defensive research continues. Reducing deployed strategic nuclear warheads to about 2,000. Has more than 1,000 tactical nukes.

RUSSIA

Is cutting deployed strategic warheads to about 2,000. Also has up to 8,000 tactical nukes. Destroying chemical stockpile. Claims bioweapons stockpile destroyed, but development may continue.

ISRAEL

Possesses only nuclear arsenal in the Middle East, 100 to 200 weapons deliverable by missile or aircraft. Believed to have chemical and biological programs.



Key
Ratified or acceded to treaty

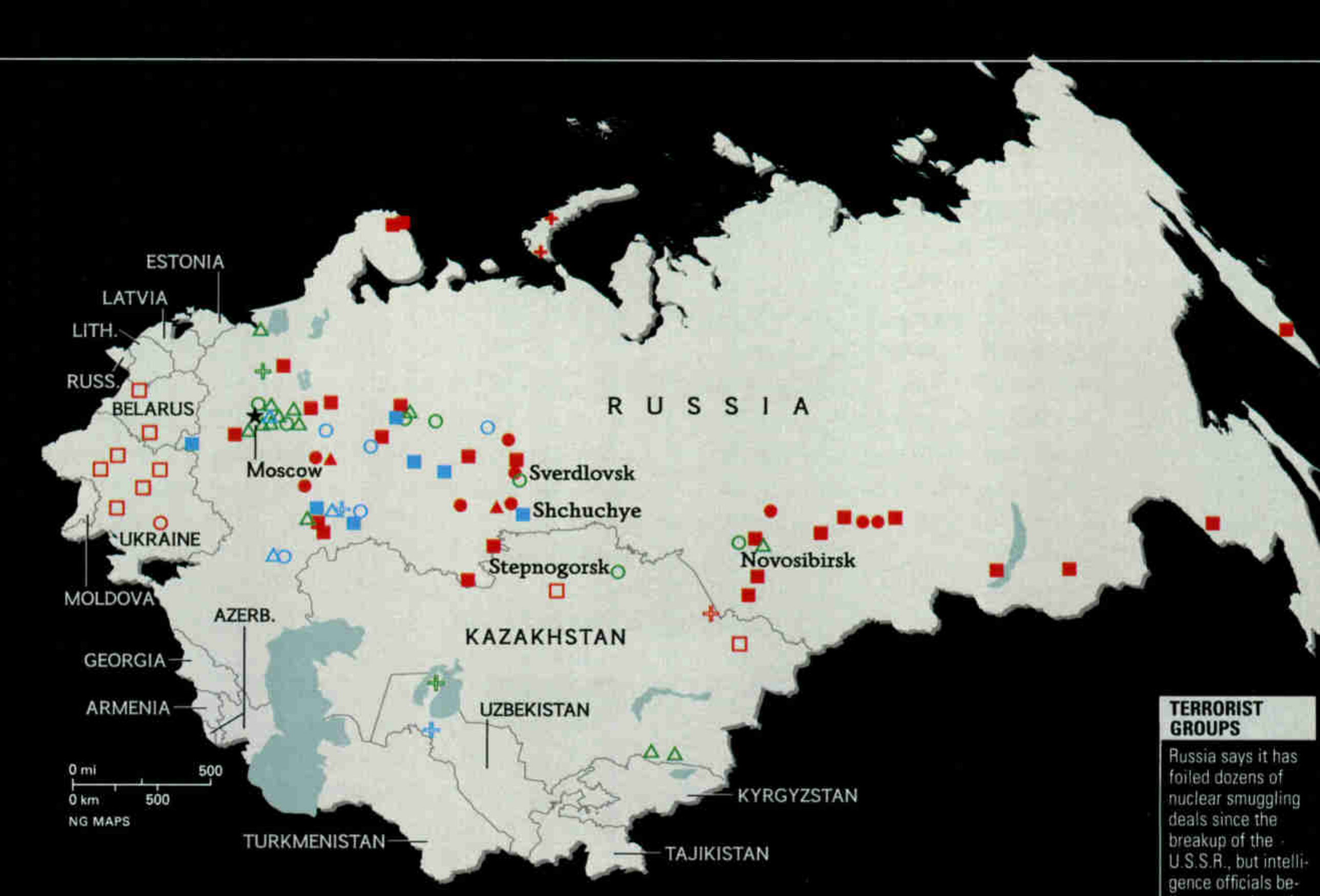
Weapons Treaties
Nonproliferation treaties have wide support, but can they be enforced? Chemical and biological weapons are especially hard to police.

LIBYA

Has tried to get nuclear weapons since 1970s. Has chemical weapons; used mustard gas against Chadian troops in 1967. Has a small bioweapons research program.

SUDAN

Has long-standing interest in acquiring chemical weapons; has sought assistance from several countries with chemical capabilities.



TERRORIST GROUPS

Russia says it has foiled dozens of nuclear smuggling deals since the breakup of the U.S.S.R., but intelligence officials believe enough nuclear material has left Russia to make a bomb. It's also known that groups like al Qaeda have been seeking loose nukes since the mid-1990s. Terrorists are also showing interest in acquiring chemical and biological weapons. Bottom line: Nobody really knows what's out there.

PAKISTAN

Successfully tested nuclear device in 1998; now thought to have 35-50 warheads. May be able to produce chemical weapons. Has limited biological research capabilities.

INDIA

Has a small stockpile of nuclear weapons and may have enough plutonium for 100-150 warheads. Has pledged to eliminate chemical weapons. Conducts bioweapons defense research.

CHINA

Has 400 nuclear weapons and enough material for many more. Maintains it never possessed bioweapons and destroyed chemical stockpiles. U.S. government has doubts.

NORTH KOREA

May have enough plutonium for one or two nuclear weapons. Has large chemical weapons stockpile and is thought to have biological weapons program.

EGYPT

Has supplied Syria and Iraq with chemical weapons. Used mustard gas in Yemen civil war in 1960s. Nuclear technology but no weapons. Believed to have a bioweapons program.

SYRIA

Has a large and advanced chemical weapons program, including stockpiles of nerve agents. Rudimentary biological program. Not pursuing nuclear weapons.

IRAQ

Used poison gas against Iran and Kurds. Was close to having nuclear bomb in early 1990s. Also has vast chemical and biological expertise, unchecked since 1998.

IRAN

Began developing chemical and biological weapons after Iraqi chemical attacks in 1980s. Building nuclear power plant with Russian help. Pursuing nuclear weapons.

has nothing to do with toxic gas. It's about biological weapons—the microscopic killers that epitomize terror, such as the smallpox "released" in Dark Winter.

In most cases, going nuclear requires a massive financial commitment: Components and expertise are hard to acquire, and facilities are necessarily large and, so, easily identified. Chemicals are hard to control and often poison those who use them. But a biological weapon can be made cheaply in a small building, even in the back of a truck, and transported with ease.

William C. Patrick should know. He directed product development for the U.S. Army's offensive bioweapons program until 1969, when the U.S. stopped producing these weapons. As Patrick points out, he can carry all the biological agent needed to wipe out a city without setting off a single alarm. Addressing New York City firefighters in Brooklyn just weeks before September 11, the grandfatherly Patrick opened a brown attaché case and pulled out bottles of simulated anthrax and smallpox.

"I carried this through airport security in Baltimore and La Guardia this morning," Patrick announced. "Not once was I asked to open this bag."

For these reasons and others, biological warfare is particularly appealing to less-developed nations and to terrorists. When the day comes that one of these players uses such a weapon, say the experts who are paid to guess such things, the dead will be counted in the tens or hundreds of thousands—especially if the agent is smallpox or some form of plague.

"While anthrax is relatively accessible to terrorists, anthrax isn't contagious," said D. A. Henderson, leader of the World Health Organization program credited with finally eradicating smallpox worldwide in 1980. "Smallpox is. There's some evidence that smallpox may already have been transported out of Russia to the Middle East, possibly to Iran or Iraq, and maybe even North Korea. If smallpox was released by these or any other countries, we'd be looking at a global catastrophe."

How a bioweapon would arrive is a matter of conjecture. Perhaps it would come by way of an air-conditioning system at a convention center in Berlin, at a soccer game in Rome, or in a midwestern shopping mall, as in Dark Winter. The container could be left at rush hour on the track of a Paris Metro station to be crushed beneath the wheels of an arriving train. Or the targets need not be human at all. Pathogens that kill food crops or livestock could be sprayed over a Japanese rice field or a grazing cattle herd in Argentina. The only sure

NUCLEAR'S NEW ERA **With the Nevada Test Site (left) sidelined by a nuclear testing moratorium, scientists are turning to 3-D computer simulations to unravel the physics of nuclear explosions. "In nuclear tests the question was always, 'Will this work?' not, 'What's the science behind it?'" says Jim Danneskiold at the Los Alamos National Laboratory. "Now that our weapons are aging, there's a lot to figure out. We don't know what happens when the plutonium in them gets old."**

bet is that it will be done quietly, in what the experts term a "silent release."

A great irony in the remarkable biological research being done today is that much of the work intended to improve and prolong human life can, with minimal effort, be turned into the most horrendous means of ending it. By manipulating genetic material, researchers can produce vaccines and treat life-threatening diseases like cancer. Genes can also be altered to produce a new strain of anthrax, against which no one has protection.

Commercial culture collections around the world—including in the United States—offer menus of biological agents for sale. The customers in nearly all cases are legitimate scientists working on biomedical research. But one rogue scientist, ordering by mail, could transform this material into a biological weapon.

Then there are the deadly germs kept alive in the cold-storage laboratories Lynn and I toured in the former Soviet Union. While Zinovy Pak says he stays awake at night worrying about security at American biotech labs, U.S. officials say they have nightmares about what's happening in the places we visited. I certainly do.

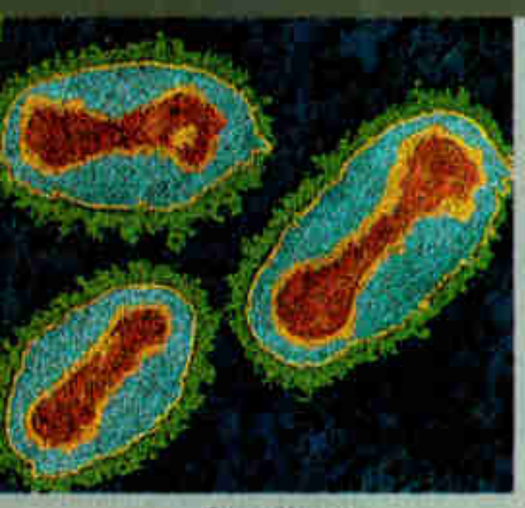
At one of these sites in Kazakhstan, we found doors to labs and refrigerators secured with dirty string and blobs of wax. We saw glass vials of plague bacteria stored in a metal can still bearing its original paper label, "peas," inside a refrigerator you'd have found in grandma's kitchen 50 years ago. If I'd tried to walk out with a vial, I'm sure I would have been stopped or arrested. But what if I worked in the lab or had the money to buy my way past trouble?

At the height of the Cold War, the Soviet biological weapons program employed some 60,000 workers in more than 50 locations. Scientists in Russia and Kazakhstan, where most Soviet labs were located, assured us that all such installations *(Continued on page 26)*

Many Weapons, Many Fears

It's almost impossible to say which weapon of mass destruction is most formidable. Nuclear weapons are by far the most powerful, but weapons-grade material is hard to acquire and bombs are difficult and expensive to build. "Dirty bombs"—explosives wrapped with radioactive material—are much easier to make but are unlikely to cause many fatalities. Most chemical agents are based on simple technology but require large quantities to inflict mass casualties. By weight, biological agents have a deadlier reach than chemicals and can be easy to get but hard to weaponize. Though not meant as a definitive guide, the chart below offers general information about the effects of some weapons on the human body.

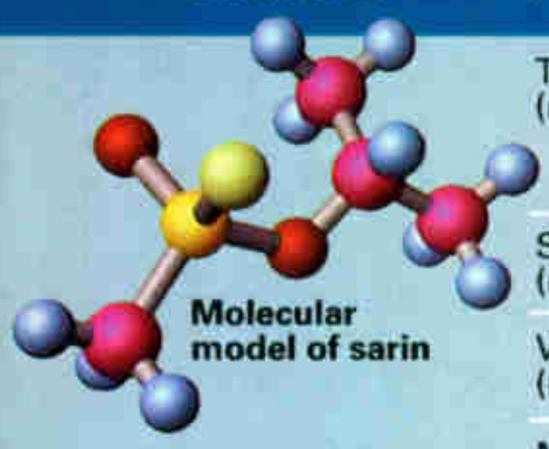
Biological



Smallpox virus

AGENT AND TYPE	CONTAGIOUS	MORTALITY (IF UNTREATED)	INCUBATION PERIOD (DAYS)	DURATION OF ILLNESS (DAYS)
Anthrax (bacterium) inhalational	No	90-100%	1-7	3-5
Plague (bacterium) pneumonic/septic	Yes	100%	1-6	If untreated, usually fatal within 6 days
Tularemia (bacterium) pneumonic/septic	No	30-40%	1-14	14 or more
Q fever (rickettsia)	No	0-1%	10-40	2-14
Smallpox (virus)	Yes	30%	7-17	10-28
Botulinum (toxin)	No	60-100%	1-5	Days to weeks
Ricin (toxin)	No	Variable	18-24 hours	Days

Chemical



Molecular model of sarin

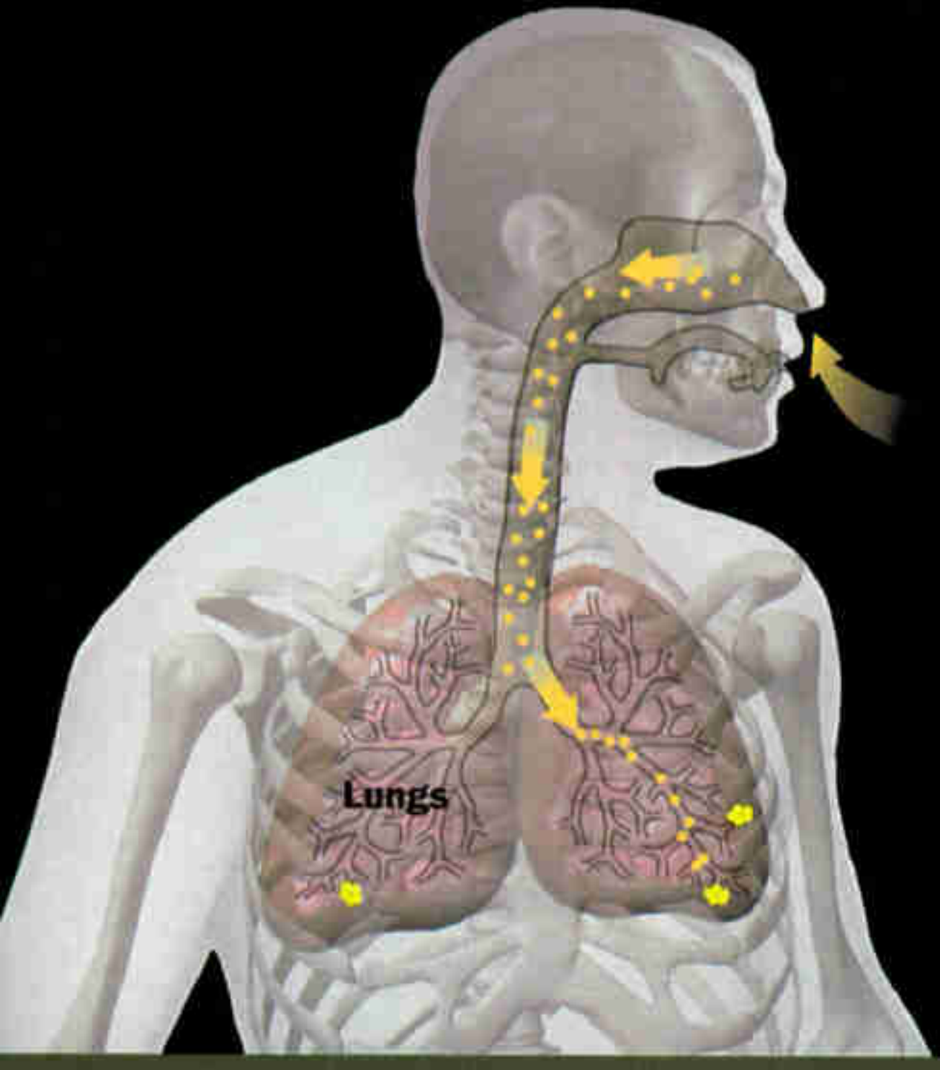
AGENT AND TYPE	APPEARANCE AND ODOR	METHOD OF ABSORPTION	RATE OF ACTION
Tabun (nerve agent)	Colorless to amber-brown liquid; slight fruity odor	Skin contact and/or inhalation	Rapid (within minutes)
Sarin (nerve agent)	Colorless liquid; no odor when pure	Skin contact and/or inhalation	Rapid
VX (nerve agent)	Colorless to amber liquid; no odor when pure	Skin contact and/or inhalation	Rapid
Mustard (blister agent)	Colorless to brownish liquid; slight odor of garlic or mustard	Skin contact and/or inhalation	Delayed for hours; long-term complications
Hydrogen cyanide (blood agent)	Colorless gas or liquid; odor of bitter almonds	Inhalation	Rapid
Phosgene (choking agent)	Colorless gas; odor of fresh mown hay	Inhalation	Immediate to 72 hours

Nuclear

Plutonium button

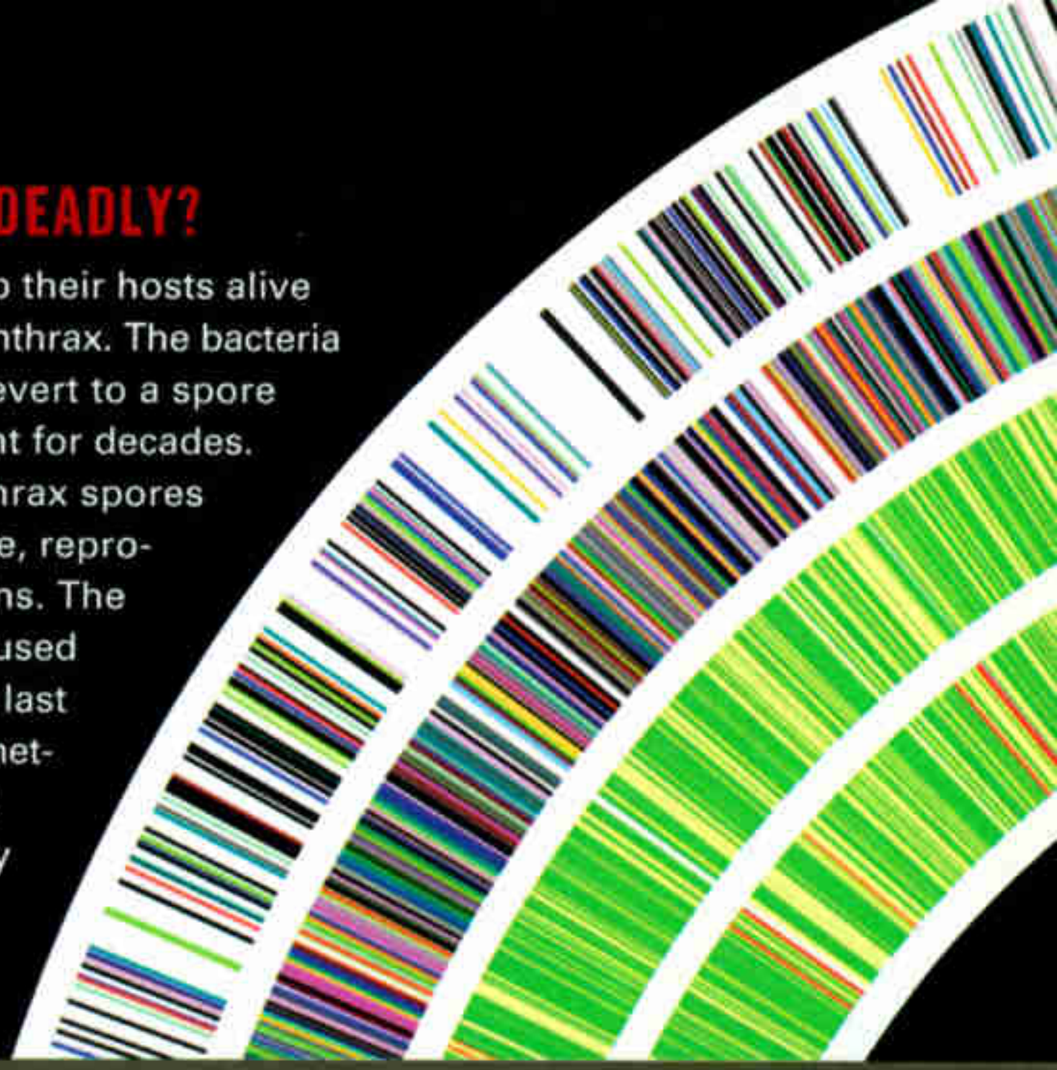
TYPE OF DISPERSAL	MATERIALS AND SOURCES
Nuclear bomb	Highly enriched uranium Plutonium (both elements available only through nuclear weapons programs)
"Dirty bomb" (radiological dispersal device)	Americium 241 (used in exploratory oil drilling and density gauges) Cesium 137 (industrial radiography gauges, food irradiators) Cobalt 60 (medical therapy, industrial irradiators, radiography) Iridium 192 (industrial uses and medical therapy) Strontium 90 (industrial heating devices)

SOURCES: ANSER INSTITUTE FOR HOMELAND SECURITY, ARMED FORCES RADIOBIOLOGY RESEARCH INSTITUTE, CENTERS FOR DISEASE CONTROL AND PREVENTION, MONTEREY INSTITUTE FOR INTERNATIONAL STUDIES CENTER FOR NONPROLIFERATION STUDIES, THE RADIATION EMERGENCY ASSISTANCE CENTER/TRAINING SITE.
SMALLPOX VIRUS SCANNING ELECTRON MICROGRAPH (SEM) AND MOLECULAR MODEL OF SARIN ART PROVIDED BY PHOTO RESEARCHERS; PLUTONIUM BUTTON PHOTOGRAPH BY JAY DICKMAN. ART BY JOHN R. ANDERSON, JR., NGM ART; ANTHRAX GENOME COURTESY THE INSTITUTE FOR GENOMIC RESEARCH.



WHY IS ANTHRAX SO DEADLY?

Most pathogens need to keep their hosts alive long enough to spread. Not anthrax. The bacteria quickly kill their host, then revert to a spore form that can remain dormant for decades. Deadliest when inhaled, anthrax spores lodge in the lungs, germinate, reproduce, and release lethal toxins. The Ames strain, a virulent form used in research, was identified in last fall's U.S. postal attacks by genetic fingerprinting. The anthrax genome has now been entirely sequenced; a partial genome map is shown at right.



EXISTENCE OF VACCINE	SYMPTOMS	TREATMENT†
Yes	Fever, malaise, fatigue, cough, difficulty breathing, toxemia, cyanosis, terminal shock	Antibiotics, supportive care
Yes (not in U.S.)	High fever, chills, toxemia, rapid progression of pneumonia, respiratory failure, cyanosis, circulatory collapse	Same as above
Yes (investigational new drug)	Fever, muscle ache, chills, cough, chest discomfort and pain, respiratory distress, exhaustion, prostration	Same as above
Yes (investigational new drug)	Fever, chills, headache, weakness, malaise, severe sweats	Antibiotics, antimalarials, supportive care
Yes	Malaise, fever, chills, vomiting, headache, backache; 2-3 days later, flat red spots appear and progress to pus-filled lesions on skin and lining of the mouth and throat.	Intravenous hydration, nutrition, pain control. Studies show promising results for antiviral drugs, if given very early.
Yes	Weakness, dizziness, dry mouth, nausea, vomiting, difficulty talking and swallowing, blurred vision, drooping eyelids, progressive paralysis, eventual asphyxia	Intensive medical and nursing care in hospital. Possible use of ventilator for respiratory paralysis. Antitoxin could be helpful if used early.
No	Fever, nausea, vomiting, bloody diarrhea, abdominal cramps, difficulty breathing, kidney failure, circulatory collapse	Inhalation: therapy for acute lung injury and pulmonary edema. Ingestion: gastric lavage, activated charcoal, fluid and electrolyte replacement.

LETHAL DOSE (in milligrams*)	EFFECTS	TREATMENT†
400 (inhaled) 1,000 (skin)	Runny nose, constricted pupils, tightness in chest, blurred vision, nausea, vomiting, convulsions, loss of control of bodily functions, respiratory paralysis	Remove victim from contaminated area; remove clothes; wash skin with soapy water; maintain airway and circulation;** provide oxygen if seizing or not breathing; seek specific antidotal treatment and general medical care.
70 (inhaled) 1,700 (skin)	Same as above	Same as above
50 (inhaled) 10 (skin)	Same as above	Same as above
1,500 (inhaled) 4,500 (skin)	Eye and airway irritation, tearing, chemical skin burns and blisters, pulmonary edema, respiratory failure	Remove victim from contaminated area; remove clothes; wash skin with soapy water; maintain airway and circulation;** provide oxygen; seek medical care.
2,000 (inhaled)	Confusion, dizziness, increased breathing and heart rate, convulsions, asphyxia	Same as above; seek specific antidotal treatment.
3,200 (inhaled)	Eye and airway irritation, pulmonary edema, choking	Same as above, but no specific antidote

**Approximate median lethal dose (50 percent of those exposed die) in milligrams per minute per cubic meter (inhaled) or milligrams per kilogram of body weight (skin). The fewer the milligrams, the more toxic the agent.*

***May be required before decontamination.*

EFFECTS	TREATMENT†
Massive explosive blast (shock wave), intense heat, electromagnetic pulse effects, intense radiation near detonation site; death from trauma or significant radiation sickness from direct ionizing radiation and from fallout.	Ionizing radiation causes no unique disease; treatment depends on type of radiation, total dose and dose rate, extent of exposure, and factors such as the age and health of the victim.
Unlikely to cause radiation fatalities but results in psychological trauma and adverse economic impact, including high cleanup costs. Danger from flying objects. Increased long-term risk of cancers. Radiation sickness unlikely. Severity of injury depends on proximity to blast, duration of exposure, and type of radioactive material.	After significant doses to the whole body, victims experience immunosuppression and bleeding, and should be treated for infection and given platelet transfusions. Radiation burns can be treated as any other burn injury. Therapies include the use of cytokines currently used to treat leukemia, lymphoma, aplastic anemia, and AIDS. Drugs such as calcium or zinc DTPA (diethylenetriaminepentaacetic acid) and Prussian blue are used to treat internal contamination.***

****DTPA and Prussian blue are currently classified as investigational new drugs by the U.S. Food and Drug Administration.*

†Effective medical treatment varies with each individual patient and with the circumstances of exposure. For more information consult your personal physician or a medical professional.

"The people that were killed—they didn't wake up that morning going to a war. They were just trying to make a living for their families."

—Roger Holtz

"SO VULNERABLE" The United States was spending 11 billion dollars a year on antiterrorism when airplanes slammed into the Pentagon and World Trade Center and redefined the word "weapon." Until that morning Max McCalman and his nine-year-old daughter, Scarlett (above), lived in the shadow of the north tower; now their apartment gets a lot more light, but they live in a whole new shadow. Scarlett has had nightmares after seeing people jump from the towers, and she talks about moving from the only home she's ever known to the country, where it's safer. "I miss the towers so badly," Max says. "It just seems we're so vulnerable now." **"THE MAGNITUDE"**

The Human Toll

Roger Holtz had years of disaster response training under his belt when his Texas unit was sent to New York, but nothing could prepare him for what he saw at ground zero. "When he came home, it took a good three or four nights before he could get through the night without tossing and turning," his wife, Annie, says. "He would try to explain to people the magnitude of the destruction, and you just can't." Trying to put form to his feelings, Roger had a memorial tattooed on his arm, and now every morning when he looks in the mirror, the tattoo reminds him of fellow firefighters who died on the job and the parents and children who became desperate street-corner posters (top left). "People died that day who won't get to enjoy what we enjoy," he says. "I don't want this nation to forget them."

TRAINING FOR TERROR **"If we're going to confront people who are willing to die, we have to take our training to the next level," says Bill Spalding (above, center), a former SWAT chief who trains police for extreme situations by subjecting them to painful hits with plastic bullets. At Disaster City (right), a training site in Texas, one of the Federal Emergency Management Agency's six WMD response units prepares emergency workers for terrorist attacks. This drill simulated a nerve gas release.**

had been destroyed. U.S. intelligence sources, barred from many of the sites, can't confirm this. But even if all the biological agents in the Soviet—or U.S.—stockpiles were destroyed, we'd still have plenty to worry about.

"The important thing is the recipes that remain in the minds of the scientists who developed them and the engineers who weaponized them," said Brian Hayes, a retired U.S. Army Special Forces major, who now inspects Soviet weapons sites for DTRA, as we traveled together in Kazakhstan. The United States considers more than 700 former Soviet weapons scientists to be security risks.

In Russia, as well as in the former Soviet republics of Ukraine and Kazakhstan, I asked repeatedly if anyone knew of scientists or engineers who'd gone abroad to work. Several people said they'd heard of this one or that who'd taken a job in the United States. But Iran? Iraq? North Korea? No. How about Syria, Sudan, Libya? No, no one. "You must remember," said Zinovy Pak, "we're next door to Iran and Iraq. Why would we want them armed with weapons of mass destruction?"

Among my fellow guests at a Tehran hotel recently was a group of 11 Russians. Neatly dressed, soft-spoken, they were there when I arrived and still there when I departed two weeks later. Each morning a white van picked them up, and each afternoon it returned them. They ate all their meals together. One evening I approached their table and introduced myself. What, I asked, are you folks doing here? "Teaching," replied a gray-haired man in an open-collared shirt. Ah. Teaching what? "Engineering." Then they excused themselves.

When I pursued this with Dr. Asad Ardalan, head of Iran's Center for Legal and International Studies, his response was equally simple: "That assistance is for our nuclear energy program. It has nothing to do with weapons."

In that case, I asked, what about dual-purpose technology? Couldn't the information

and expertise being supplied by these Russians for peaceful purposes also be used to build weapons? His response was, I thought, a classic of its kind—evasive, certainly, but not untruthful. "You may use a knife to peel a piece of fruit or to kill someone. So if I have a knife in my hand, what does it mean? It depends on the observer's point of view."

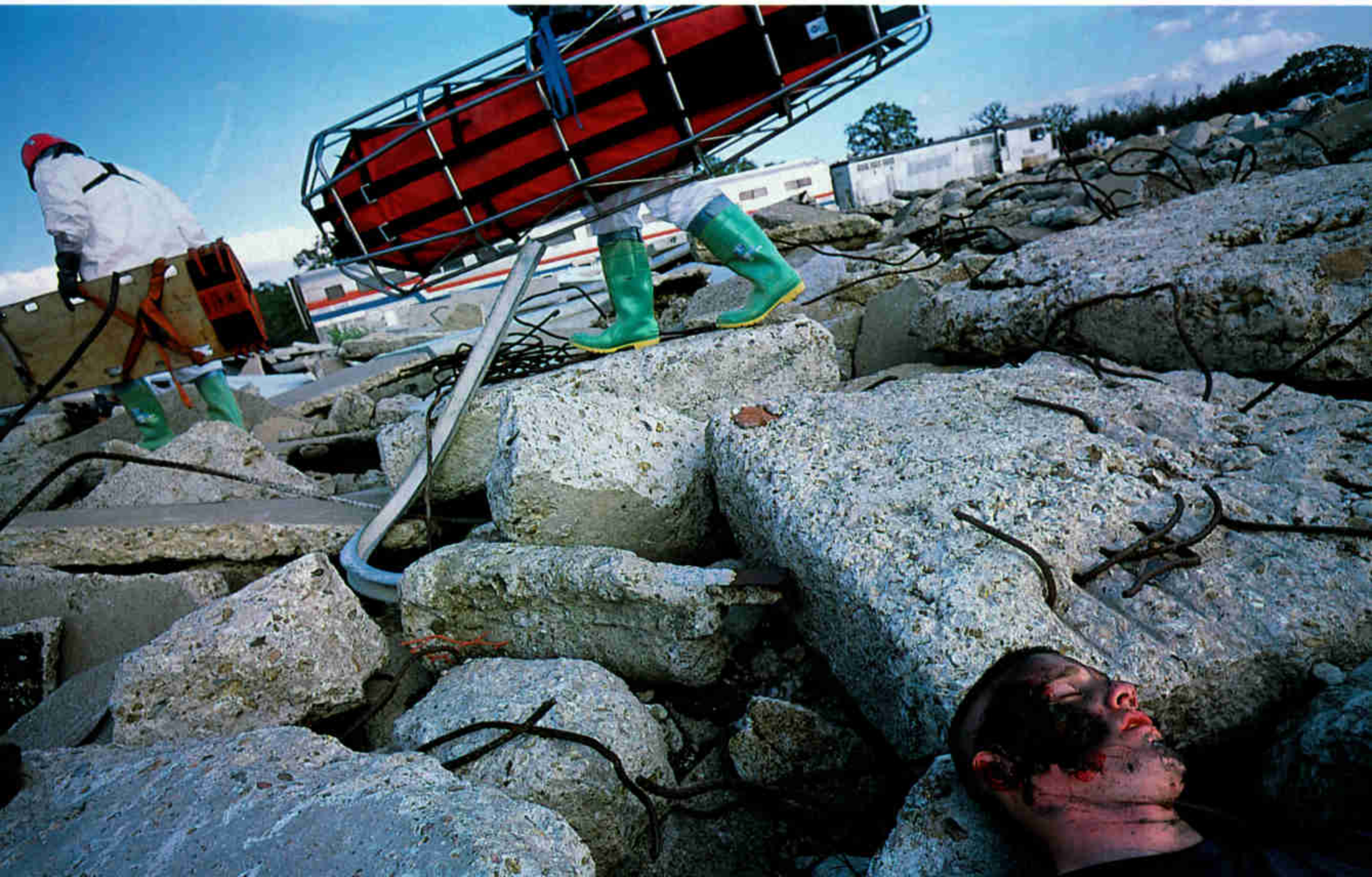
At Stepnogorsk about 20 years ago, the Soviet military flung up a huge bioweapons factory on the Kazakh steppe in violation of the Biological Weapons Convention, which the Soviet Union had signed in 1972, joining the United States and more than a hundred other nations. On the site today, Yuriy Rufov is the director of an enterprise called Biomedpreparat, which is a big name for a little company. Except for Rufov and a few aides, huddling in their coats in a bare, unheated office building the subzero morning we visited, Biomedpreparat doesn't exist. It has no factory, no machinery, no laboratories.

In the Soviet era, Stepnogorsk was a "secret city," one of 30 or so locations that did not appear on maps, and the plant, part of the Soviet biotechnology program known as Biopreparat, manufactured anthrax for the military. Since 1996 the United States has spent 2.5 million dollars to turn most of the vast plant into rubble. Washington also agreed to help Biomedpreparat convert what remains into a pharmaceuticals factory and get the former staff back to work. That hasn't happened, to Rufov's frustration.

Rufov insisted that he and his colleagues wouldn't easily offer their services to other governments. "We were all educated to believe in the rightfulness of the Soviet Union and the Communist Party. Going to work in the Middle East would go against everything we spent most of our lives believing in."

Yet thousands of those who were the Soviet Union's elite—granted the best of salaries, housing, food, schools, free vacations on the Black Sea, and other privileges that the state could offer—are today unemployed and barely able to put bread on the table. It doesn't take much imagination to realize that some of them, no matter how loyal or patriotic, could eventually be forced to sell what they know.

Of the 680 scientists and technicians who worked at the Stepnogorsk plant in its final days, said Rufov, 500 accompanied the departing Red Army to Russia; 112 remained in Stepnogorsk, paid by the United States to dismantle the plant; 16 were engaged in monitoring contamination of the ruins, also on the U.S. payroll; and 52 were working for a new medical manufacturing company nearby. According to



Rufov, only a few former employees have ever gone to work abroad. Chief among them was Stepnogorsk's onetime director, a Kazakh named Kanatjan Alibekov.

A Soviet army physician and biologist, Alibekov fled to the United States in 1992 and filled the government's ear with chilling stories about the Soviet bioweapons program. His crowning achievement had been the perfection of Anthrax 836, the U.S.S.R.'s most powerful weapons-grade anthrax, four times more deadly than its predecessor. Made operational in 1987, it is an extremely fine, silky, grayish brown powder that can drift invisibly for miles.

Today, his name Americanized to Ken Alibek, he is chief scientist at a biodefense company in northern Virginia, as well as a professor of microbiology at a local university. The day I visited Alibek in his office, he looked like most American academics, wearing a black turtleneck and skimming a research grant application.

As eventually happens to some defectors, Alibek has been chided by his former CIA handlers for exaggerating information in an attempt to enhance his value. Yet when I asked him about former Soviet bioweaponeers now working abroad, his reply was matter-of-fact.

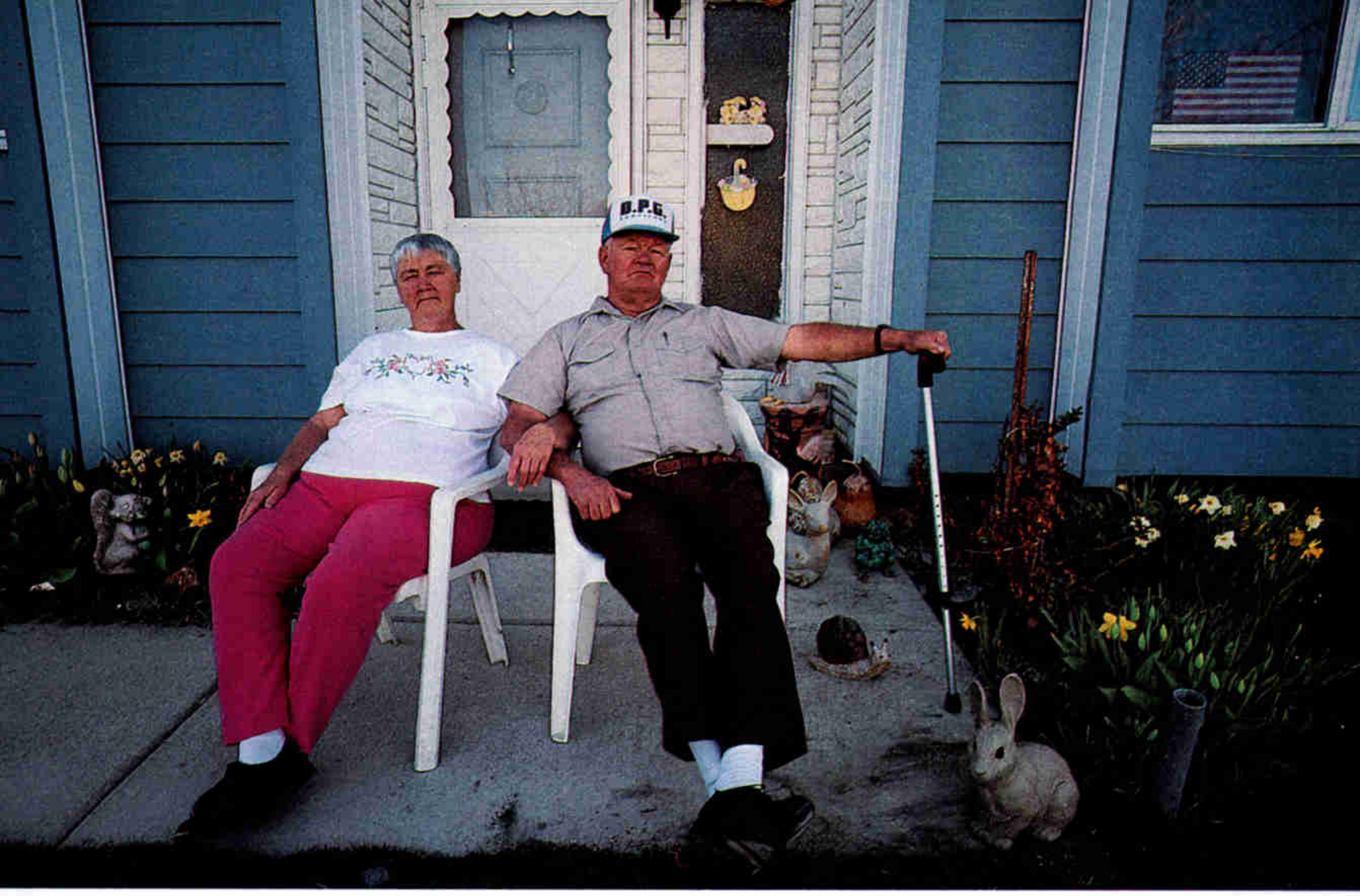
"Most are in Russia," he said in heavily accented English. "Some are here in the U.S.; a few are in Europe and Asia. There may be a couple in Iran, but if so, we're not talking big numbers. Very few." But, he added, "A few is all it takes."

If, in fact, unemployed former Soviet specialists are giving in to temptation, Russians charge that Americans must accept a piece of the blame. "The Americans were in a great hurry to destroy," Rufov said bitterly as he showed Lynn and me Alibek's old facility back in Kazakhstan. "But now that it's time to rebuild, they're dragging their feet. Our people can't wait much longer."

Rufov led us through the ruins of the former anthrax factory—ten sprawling, white, concrete buildings on the scale of a Detroit auto plant. First we pulled disposable white coveralls and respirators over our parkas, since there still could be faint traces of anthrax inside.

"The construction is extraordinary," Rufov said, pride evident in his deep voice, as we climbed the stairs of Building 221, the main structure, a hundred feet high and two football fields long. We stepped gingerly around shattered beakers, yellowed magazines and safety manuals, and drained vodka bottles.

"No government could afford this today," said Rufov. "Of course, 90 percent of Soviet industry was connected with the military. That's what led to the collapse of the Soviet Union."



TOIL AND TROUBLE **For 41 years Adrian Hawkins worked at the Dugway Proving Ground in Utah, where the U.S. Army tested chemical and biological weapons. He "got bit" by a nerve agent once, was given a host of experimental shots, and now has multiple sclerosis, like a number of co-workers. But, he says, Dugway "gave me a good living." In Stepnogorsk, Kazakhstan (left), scores of workers at the world's largest anthrax plant wonder what they'll do now that it's being dismantled.**

On the top level I walked into Alibek's old office. The mandatory Soviet-era portrait of Lenin was gone from the wall, and so was the glass in the windows. A bird lay dead on the floor, frozen solid.

The plant's 5,000-gallon fermenting tanks, all ten of them, had been removed, decontaminated, and destroyed. Left behind were gaping holes in the concrete. Laborers in felt boots trundled out heavy valves and pipes. In a former life they were biologists. "The change has been so radical for them," said Rufov. "They're suffering. We all are."

In Washington former Senator Nunn is sympathetic. "The human side of reducing the WMD threat has been the least tended to and the least successful, but it's also the most difficult," said Nunn, who now heads the Nuclear Threat Initiative, a charitable organization he co-founded with fellow Georgian Ted Turner. Although the United States contributes to keeping 30,000 former Soviet scientists financially afloat, some members of Congress believe they're being asked to bankroll the Russian military.

"They think that the Russians are still working on new weapons," said Nunn, "and by relieving pressure on another part of their economy, we'd in effect be paying them to expand their military."

They're wrong, says Nunn. "The homeland defense of the United States begins in the former Soviet Union. And any member of the Congress who doesn't understand that, especially since 9/11, well, I just don't get it."

After a year's worth of finger-pointing and a historic reordering of national priorities, many uncertainties remain about how much the United States—or any society—can do to protect itself from WMD.

Beyond giving intelligence and law enforcement agencies new equipment and new powers, tightening security *(Continued on page 34)*

GROUNDED FOR LIFE She used to be a top gun, the only female helicopter pilot in her squad, but now Ronda Wilson finds life most comfortable in a fetal position. The reason, she says: biological friendly fire. In 1998 the Pentagon, fearful of germ warfare's growing threat, began to vaccinate all military personnel for anthrax. "Basically, we were told to 'shut up and stick your arm out,'" Ronda says. She

stopped menstruating after the first shot, and by the third of the six-shot series had lost a third of her body weight due to stomach paralysis. As the vaccine's alleged casualties—including six deaths—mounted, soldiers began refusing it; 400 so far have either resigned or been court-martialed. But with untreated inhalational anthrax almost invariably fatal, the vaccine may be a risk worth taking. In June the U.S. government announced it would stockpile it for civilians.

His dream: One day she'll get better, and they'll get in their red van—the one they traveled in as newlyweds—and take a trip.

JUNE 27, 1994 It was a normal summer night until the nerve gas arrived. One minute the Kounos were watching TV in their living room; the next minute the dogs were dead and Sumiko was in a coma. The police in Matsumoto, Japan, had never seen anything like it, and they accused Sumiko's husband, Yoshiyuki, of poisoning her and scores of other people in the neighborhood with household chemicals. No, he insisted—he loved his wife. **MARCH 20, 1995** A hundred miles away, five Tokyo subway trains filled with the same gas—sarin—during the morning commute, sending thousands to the hospital and killing 12. The blame quickly settled on Aum Shinrikyo, a doomsday cult that had already tried and failed to cause mass casualties with anthrax and botulinum. The Matsumoto release had been their first success. **JANUARY 16, 2002** Sumiko is still paralyzed. She's returning to the nursing home after yet another hospital stay—this time for pneumonia. Yoshiyuki doesn't hate the terrorists who crippled his wife; he doesn't have time. "Every night after work, he goes to her," photographer Lynn Johnson says. "He puts lotion on her hands and her face, he puts balm on her lips, and he holds her and tells her about his day. He tells her about the kids—they have three adult children—and he just talks sweetness to her. It really hit me when I looked up and saw my interpreter with tears in his eyes. Yoshiyuki was telling her she was beautiful."

The Human Toll

—Picture text by Glenn Hodges
National Geographic Writer

In a very real sense, whenever weapons of mass

at our borders, training hospital staffs for outbreaks, and building vaccine stocks—all belatedly under way—almost nothing can be done to prevent a biological weapons attack. So what else can we do?

Dr. Margaret Hamburg, a former public health commissioner for New York City who now directs biological programs for the Nuclear Threat Initiative, advocates moving forward at full speed.

"We need to improve intelligence on bioweapons by enlisting medical and scientific experts in the effort, and we need to improve security in our research labs. We also have to prepare for the worst by strengthening the public health infrastructure—educating health care providers to recognize unusual diseases, and upgrading our health care system to respond to a mass-casualty event. If we were attacked today, our system would still be overwhelmed."

As part of what Hamburg describes as "the good news," the Bush Administration is calling on Congress to approve the largest public health budget in history, including the acquisition of enough smallpox vaccine by 2003 to inoculate all Americans if needed.

Even these dramatic steps may not protect the United States, or any nation, from the full weight of the *terror* in bioterrorism. Americans learned a year ago that a few anthrax spores, or even a spoonful of talcum powder, sprinkled in an envelope can do a huge amount of damage.

Only five people died from the genuine article, which they inhaled from mailed envelopes. Yet Washington, D.C., and other East Coast cities were thrown into high anxiety. Military surplus shops reported a run on gas masks—none of which would have been effective unless the buyers put them on immediately and kept them on 24 hours a day until the all-clear was sounded. "Unlike with nukes, not even an actual event is needed," a federal intelligence expert said of the anthrax scare. "Just a simple hoax, and you can have mass panic and economic upheaval."

MORE ON OUR WEBSITE

Meet DOWNWINDERS, victims of fallout from nuclear tests, then see SAFETY MEASURES, a practical guide for surviving WMD attacks, at **nationalgeographic.com/ngm/0211.**

While the world watches its most likely target, the United States, mobilize to deal with this new threat—hoping that the long night will never come—many in the antiterrorism field are disconsolate.

"Because we've had what appears to be a quick, high-tech victory in Afghanistan, we're back to putting our faith in technology as the quick fix," the intelligence source told me. "But gadgets like bio and chem sensors are only one tool in your kit. If I'm your adversary, I know you have sensors and I'll find a way to defeat them. We still haven't learned the hard lesson—that we're no longer different from the rest of the world."

Nor does the rest of the world seem to have learned its own lessons. Those who've survived attacks, experiments, and accidents—in the former Soviet Union, in Japan, in Iran and Iraq—are scorned and ignored. It's as if the things that they talk about are just too terrible to hear.

Certainly, as Lynn and I traveled the world on this assignment, there were times when what we saw and heard became unbearable: the freakish human fetuses preserved in jars of formaldehyde in Kazakhstan; the Utah downwinder riddled with cancer; the middle-aged Russian brothers with the minds of infants.

In Iran, for example, there's Sasan Safavian. Gaunt and fragile, he speaks with great difficulty, his words choked off again and again by a cough that forces claws of pain deep into his chest. Propped on a cushion against the wall of his Tehran apartment, he holds a bony hand to the faint sunlight filtering through a curtained window to shield his sensitive eyes. In the past 18 months he has lost 40 pounds. Safavian began dying in 1983 when, as a 16-year-old ambulance volunteer, he was caught not once but twice in Iraqi poison gas attacks.

"Frogs and birds were lying dead all over the ground. . . . My throat was bleeding, and blood-filled blisters appeared all over my body. . . . We had no gas masks, and we hadn't been trained. We didn't believe one Muslim country could use chemical weapons against other Muslims."

In Russia 80-year-old Olga Vyatkina leans

death are unleashed, all humanity is downwind.

heavily on a cane, staring dry-eyed at the snow-banked gravestone where she buried her only child, Alexander, in 1979. He was 27. Alexander was one of 68 known victims of the world's worst outbreak of inhalational anthrax. He collapsed on the street a few blocks from Compound 19, in the city of Sverdlovsk, where the Soviet Army secretly produced anthrax as part of the U.S.S.R.'s vast bioweapons program.

"They wrote 'sepsis' on the death certificate. Then we heard rumors that it had been anthrax. My husband and I were terribly afraid. Our son had spent the night before he died at home with us. The people in the morgue refused to dress the body, so we did it ourselves. To this day, no one has ever told us that anthrax killed him.They gave us 40 rubles, and I used it to buy a dress for the funeral."

And in the United States there's Preston Truman, who began chemotherapy and radiation therapy for lymphoma as a teenager. Today, at 50, he suffers from a collection of excruciating diseases, which he mocks as "moans, groans, stones, and bones." At his tiny farmhouse in Idaho, Truman's earliest memory is of a morning in 1955. It was in Enterprise, Utah, and he was three, sitting on his father's knee before dawn. Together they watched the sky explode. A nuclear bomb test had gone off 100 miles upwind at the Nevada Test Site. Many more were to follow.

"Later on I remember people talking mysteriously about all the cancer in town: Did it come from drinking too much soda pop? You know, that kind of thing. Guess they just couldn't believe that their own government would do this to them. And then lie about it. I mean, hell, this is the United States."

These far-flung people, who've never met, never heard of each other, share a relationship none wants. They're victims of weapons of mass destruction. And like Truman, they've all been lied to—still are—by the institutions they were taught to trust. "The minute a government crosses the threshold and goes nuclear, it has to start lying," said Truman. Or crosses the line into any kind of WMD.

After ignoring him for four decades, the United States finally acknowledged that it made Truman and others sick, although the compensation it offered would cover only a fraction of their medical expenses. The Russian government still denies that Olga Vyatkina's son breathed in deadly anthrax spores released from Compound 19. And the government of Iran gives Sasan Safavian inhalers and bags of pills, even though there is no cure for the damage Iraqi chemicals inflicted on his body.

What goes for these three victims applies to tens of thousands more: the *hibakusha*, or atomic bomb victims, of Japan; the Agent Orange victims of Vietnam; the Kurdish poison gas victims of Halabjah in northern Iraq; the ill-informed test site workers and the residents of quiet neighborhoods downwind from those sites whom we met in Kazakhstan and in Utah.

It even applies to the unafflicted. My wife was outside Tokyo's Kamiyacho subway station in 1995, when the Aum Shinrikyo cult released sarin gas on the train she usually rode to work. She walked away unharmed, but it's never far from our minds. On September 11 we lost a friend in the World Trade Center; another was killed at the Pentagon. Many people reading these words have similar stories to tell. Even those who haven't lost someone can't stop thinking about it. In a very real sense, whenever weapons of mass death are unleashed, all humanity is downwind.

In September 1957, on the day Preston Truman started kindergarten, the teacher passed out pocket-size booklets prepared by the U.S. Atomic Energy Commission to assure the children and their parents that all was well.

A cartoon shows a bowlegged cowboy holding a Geiger counter going "click, click, click." Over the cowboy's ten-gallon hat is a giant question mark—just like the one that floats over all of us these days, roiling our thoughts with vague FBI terrorist warnings, prompting prayers that a real Dark Winter is not about to descend. "We can expect many reports that Geiger counters were going crazy here today," says Truman's atomic booklet. "Reports like this may worry people unnecessarily. Don't let them bother you."

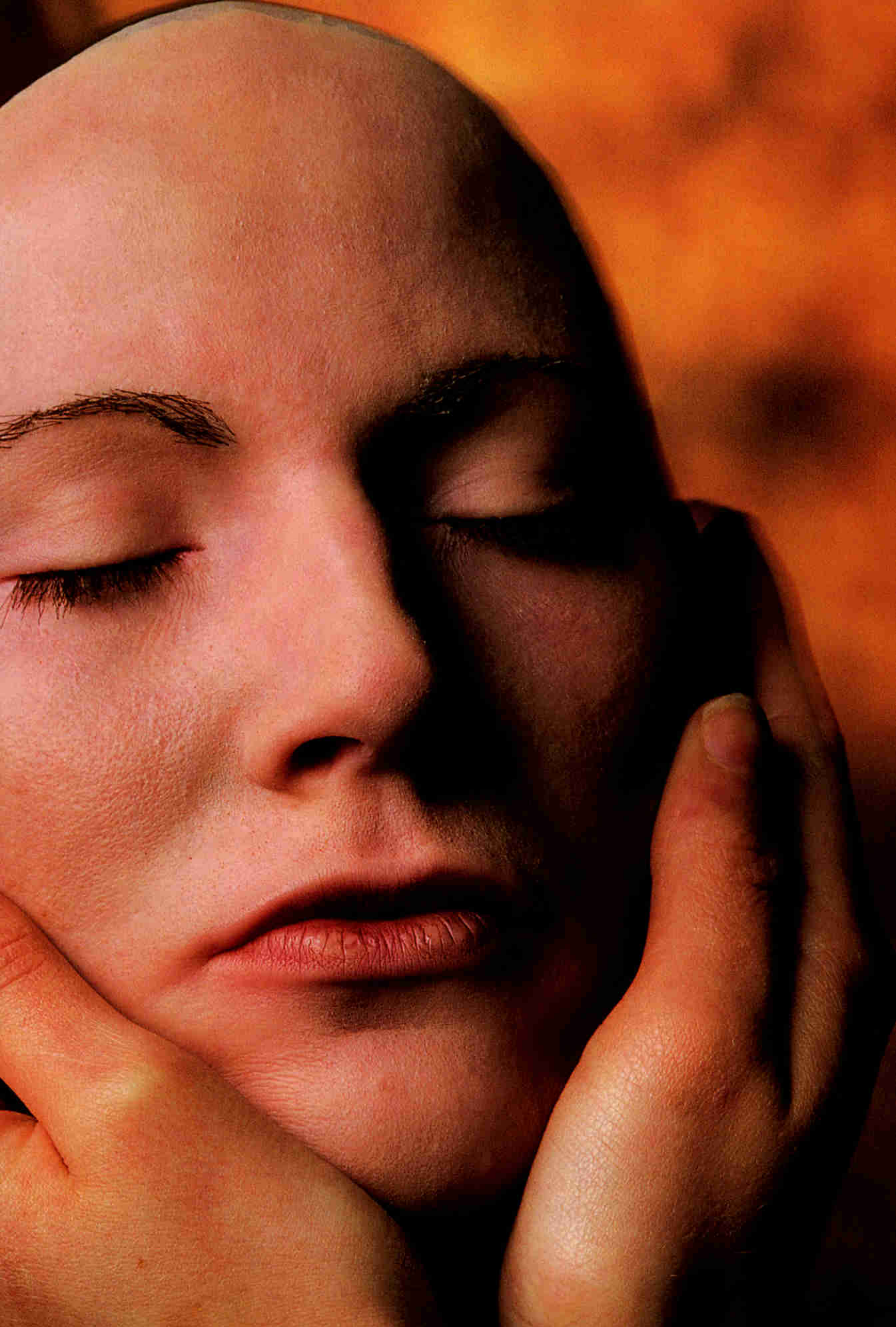
If only that were possible. □

A silicone mask held by the woman who wears the same face captures the look, almost the feel, of human skin. But no simulation can capture the complexity of the body's largest organ—the one that keeps us in touch with the world.

UNMASKING SKIN

By JOEL L. SWERDLOW

Photographs by SARAH LEEN



A man stands silhouetted behind 21 square feet of skin substitute known as Integra. Unfurled, the skin of a human adult would roughly match the size of this sheer curtain, made from a mix of cow-tendon collagen, shark cartilage, and silicone. Skin substitutes can help burn victims like former firefighter Tom Stevens (right) grow their own new skin.

Tom Stevens sits across from me at a café in a small town in upstate New York. He has a handsome face and a powerful build. But his ears are stubs tucked tightly to the sides of his head, and when he takes off his baseball cap, I see that his scalp, except for a thin strip, is a mass of scar tissue.

"I lost my helmet somewhere in the house trailer just before the flashover hit," says Stevens.

"It was about 2,000 degrees Fahrenheit in there when I jumped out the window."

Five years ago Stevens was a volunteer firefighter. Now, preparing for his sixth major reconstructive surgery, he laughs. "I'm learning more about skin than I ever wanted to know."

If you took off your skin and laid it flat, it would cover an area of about 21 square feet, making it by far the body's largest organ. Draped in place over our bodies, skin forms the barrier between what's inside us and what's outside. It protects us from a multitude of external forces. It serves as an avenue to our most intimate physical and psychological selves.

This impervious yet permeable barrier, less than a millimeter thick in places, is composed of three layers. The outermost layer is the bloodless epidermis. The dermis includes collagen, elastin, and nerve endings. The innermost layer, subcutaneous fat, contains tissue that acts as an energy source, cushion, and insulator for the body.

From these familiar characteristics of skin emerge the profound mysteries of touch, arguably our most essential source of sensory stimulation. We can live without seeing or hearing—in fact, without any of our other senses. But babies born without effective nerve connections between skin and brain can fail to thrive and may even die.

Laboratory experiments decades ago, now considered unethical and inhumane, kept baby monkeys from being touched by their mothers. It made no difference that the babies could see, hear, and smell their mothers; without touching, the babies became apathetic and failed to progress. Deprived of their mothers, they did not explore as young primates normally do; rather they "threw themselves prone on the chamber floor, crying and grimacing all the time, or huddled against a chamber wall, rocking back and forth with their hands over their heads or faces," according to one report.

For humans insufficient touching in early years can have lifelong results. "In touching cultures, adult aggression is low, whereas in cultures where touch is limited, adult aggression is high," writes Tiffany Field, director of the Touch Research Institutes at the University of Miami School of Medicine. Studies of a variety of cultures show a correspondence between high rates of physical affection in childhood and low rates of adult physical violence.

While the effects of touching are easy to understand, the mechanics of it are less so. "Your skin has millions of nerve cells of various shapes at different depths,"

SARAH LEEN AND NATIONAL GEOGRAPHIC PHOTOGRAPHER MARK THIESSEN (LEFT)

This composite of ten magnetic resonance scans of an 18-year-old reveals the fragile nature of the organism that resides beneath human skin. Without skin as a barrier, our insides could not survive the hostile world of bacteria, viruses, temperature swings, and ultraviolet radiation. Magnetic resonance imaging (MRI) joins

MAGNETIC RESONANCE IMAGING (MRI) BY SIEMENS MEDICAL SOLUTIONS, INC.; DIGITAL COLORATION AND COMPOSITE BY CHRISTOPHER P. SLOAN, NGM ART

x-rays, ultrasound, and CT scans as a diagnostic tool doctors can use to see through skin, which they once could breach only with blades. They can peer into the central nervous system to investigate stroke, evaluate muscle and joint abnormalities, such as an athlete's torn ligament, even detect vascular, or blood vessel, disease.

explains Stanley Bolanowski, a neuroscientist and associate director of the Institute for Sensory Research at Syracuse University. "When the nerve cells are stimulated, physical energy is transformed into energy used by the nervous system and passed from the skin to the spinal cord and brain. It's called transduction, and no one knows exactly how it takes place." Suffice it to say that the process involves the intricate, split-second operation of a complex system of signals between neurons in the skin and brain.

This is starting to sound very confusing until Bolanowski says: "In simple terms people perceive three basic things via skin: pressure, temperature, and pain."

And then I'm sure he's wrong.

"When I get wet, my skin feels wet," I protest.

"Close your eyes and lean back," says Bolanowski.

Something cold and wet is on my forehead—so wet, in fact, that I wait for water to start dripping down my cheeks. "Open your eyes," Bolanowski says, showing me that the sensation comes from a chilled, but dry, metal cylinder. The combination of pressure and cold, he explains, is what makes my skin perceive wetness.

He gives me a surgical glove to put on and has me put a finger in a glass of cold water. My finger feels wet, even though it's not touching water. My skin, which seemed so reliable, has been deceiving me my entire life. When I shower or wash my hands, I now realize, my skin feels pressure and temperature—it's my brain that says I feel wet.

Perceptions of pressure, temperature, and pain manifest themselves in many different ways. Gentle stimulation of pressure receptors can result in ticklishness, gentle stimulation of pain receptors in itching. Both sensations arise from a neurological transmission, not from something that physically exists.

Scratching puts a quick end to a variety of itches by creating a counter-irritation on the skin that diverts the brain's perception of the itch. Although no one has identified exactly what part of the brain receives itch signals, itches trigger activity in areas of the brain that prompt arm movement, presumably initiating a scratch response.

But there is more to relieving some itches than a simple scratch. "Few medical researchers pay serious attention to itches even though everyone experiences them," says Goh Chee Leok, clinical professor of dermatology at the National Skin Centre in Singapore. "There are pain clinics but no itch clinics."

Last year Leok and colleagues from all over the world gathered in Singapore for the first international itch meeting. Findings reported at the meeting revealed some curious patterns. Temperature, for example, can inhibit an itch. Also, if a finger on one hand itches and you put the same finger on the other hand in cold water, the itch on the first finger goes away. Imposing pain in one place can inhibit an itch in another place.

When it comes to identification, the VeriChip goes a step beyond an inked fingerprint. Technicians can input such data as name, birthday, and blood type, then implant the chip in the skin. Medics can scan it to identify an unconscious or disoriented person.

"CAN YOU IMAGINE an itch that never goes away no matter what you do?" The question comes from a young woman with psoriasis. Her knees are covered with red blotches, scaly and peeling.

Skin cells migrate from their birthplace at the base of the epidermis outward to the surface of the skin. This movement, in normal skin, takes about a month. In people suffering from psoriasis—thought to be an immune-related disease, in which the body's defenses against infection attack the body's own tissues—the shedding is accelerated, sometimes to as few as four days. As a result the skin may become a less effective barrier.

Other causes of persistent and at times incessant itching include kidney disease, stroke, brain tumor, *liver disease*, *Hodgkin's disease*, and other malignancies of the lymphatic

system. Finding relief for patients plagued by this kind of itching presents a major challenge to the medical community.

Skin, I'm realizing, is under constant assault, both from within the body and from forces outside. Repairs occur with varying success.

Take the spot where I nicked myself with a knife while slicing fruit. I have a crusty scab surrounded by pink tissue about a quarter inch long on my right palm.

From the familiar characteristics of skin emerge the profound mysteries of touch, arguably our most essential source of sensory stimulation.

Under the scab, epidermal cells are migrating into the wound to close it up. When the process is complete, the scab will fall off to reveal new epidermis. It's only been a few days, but my little self-repair is almost complete.

Likewise, we recover quickly from slight burns. Touch a hot burner? Put your finger in cold water. Chances are you will have no blister, little pain, and no scar.

Severe burns, as Tom Stevens and others like him can attest, are a different matter. Stevens suffered some second-degree burns that destroyed epidermis and parts of the dermis, as well as extensive third-degree burns in which all the skin was destroyed. His burns have forced him to establish a whole new relationship with his skin.

"My hands are bothering me today," he says during one of my winter visits to his home in New York. "I have trouble keeping them warm on cold days like this." Stevens's hands get cold because the skin on them is mostly gone, replaced by scar tissue. He also has trouble in hot weather. Healthy skin has about 650 sweat glands per square inch, but Stevens's hands can't sweat. "I don't think most people realize how much heat they release through their hands," he says. Stevens must also battle itching and numbness. "If I rub on moisturizing lotions it helps. It feels like blood returning to a limb after it's fallen asleep," he says.

Sometimes the most difficult areas for burn victims are areas that were not burned at all. To cover areas exposed by severe burns until scar tissue can grow, surgeons often "harvest" skin from healthy areas, causing the equivalent of new second-degree burns.

If patients are too seriously burned to endure this additional damage, surgeons attempt skin grafts from other sources. Success with cadaver skin is limited, because in most cases the patient will shortly reject it. Immunosuppressants, which normally aid in preventing rejection of transplants, are of little value because burn patients are at such high risk for infection that it's not safe to suppress their immune systems in any way.

Pigskin, which resembles human skin more closely than that of any other animal, was once used as a temporary bandage to protect the burn as it healed. Since the 1970s doctors have been working to develop other materials that mimic the structure of the dermis. Some are made from cow collagen and shark cartilage, and scientists are also working with silicone. Applying such material to burned areas encourages damaged dermis to create new collagen of its own. Other advances include the use of small samples of the patient's own normal skin to grow larger sheets of new skin on an artificial dermis. This skin is then grafted onto the patient.

TWO MONTHS after the attacks on the World Trade Center and the Pentagon left behind many serious burn victims, I visited the physical therapy room at the Burn Center of the Washington Hospital Center in Washington, D.C. "If you see us laughing or joking, don't take it wrong," a handmade placard read. "We're trying to relieve the stress."

James Jeng, associate director of the center, explained that the first thing surgeons do after a burn patient enters the hospital is cut away the burned tissue with scalpels. "What we do now is terribly bloody and barbaric," says Jeng, who is working to devise a way to use computer-directed lasers to achieve this first step with more precision and less damage.

"But the greatest damage from burns often occurs in the days after the patient arrives at the hospital," Jeng explains. "Blood flow to surrounding skin is reduced, which converts living, unharmed tissue to dead tissue,

Skin has long served as a canvas for the artistic and the spiritual. Here, a Thai man has just received a ritual tattoo at an annual Buddhist ceremony. His tiger tattoo symbolizes longevity and wards off evil.

For centuries humans have tried to alter what heredity determines, and attempts to either lighten or darken skin have long been part of beauty regimens.

dramatically increasing the severity of the injury." The process can continue for one to two days after the burn.

Jeng, who has been operating on burn and other trauma patients for nearly a decade, believes that the next major breakthroughs in burn treatment will include not only better artificial skin but also the prevention of this conversion process.

That burned skin can hurt healthy skin is news to me. "But think about when we were hunter-gatherers," says Jeng. "Humans could survive and go on with an injury that was not too bad, but they would die if their injuries made them so slow and weak that they'd endanger the entire group. Once you're burned past a certain point, nature may intend for you to die."

Less immediately but just as dramatically damaging to skin are burns caused by the ultraviolet radiation in sunlight.

Epidemiological evidence as far back as the late 19th century suggested a link between sun exposure and deaths from cancer, but few experts noticed. In the 1940s Sigismund Peller of the Johns Hopkins School of Hygiene theorized that exposure to sunlight during childhood and adolescence, though it may result in cancer of the skin or lips, helps to prevent the development of deadly cancers in other parts of the body less accessible for treatment.

While sunlight is necessary for the human body to be able to produce vitamin D, repeated sunburn and prolonged exposure to ultraviolet radiation from sunlight can cause irreparable damage to the DNA within skin cells and suppress the immune system, allowing cancerous cells to take root. Cases of melanoma, the most serious form of skin cancer, have nearly doubled in the United States in the past two decades, making this one of the most rapidly increasing forms of cancer. More than 50,000 new cases are reported to the American Cancer Society each year. It's likely that many more go unreported.

THE HEALTH OF OUR SKIN and its ability to perform its protective functions are crucial to our well being, but the appearance of our skin is equally—if not more—important to a vast number of people on this planet. And what's appealing is a matter of considerable subjectivity.

Take skin color. The color of skin depends mainly on melanin, a brownish pigment produced by melanocytes in the epidermis. All people have about the same number of melanocytes; it is the amount of melanin they produce that varies among lighter and darker skinned people.

Heredity is a primary determinant of how much melanin the melanocytes produce in any given person. But for centuries humans have taken measures to alter what heredity determines, and attempts to either lighten or darken skin color have long been part of various beauty regimens.

In the 1800s *(Continued on page 54)*

MAP CREATED BY GEORGE CHAPLIN, CALIFORNIA ACADEMY OF SCIENCES

Australian Aborigine Glenys Martin holds a map that charts predicted human skin colors based on global ultraviolet radiation intensity and precipitation levels. Within the limits of individual genetic makeup, more radiation results in greater amounts of skin-darkening melanin produced by the skin for protection. Yet with the effects of human migrations and cultural habits, people in one place can show tremendous variation in skin tone—like students from the Washington International Primary School. Equally diverse are biases that have evolved relative to skin color. But, as anthropologist Nina Jablonski says hopefully, "We're living in a time when people are ready to stop basing value judgments on skin color."

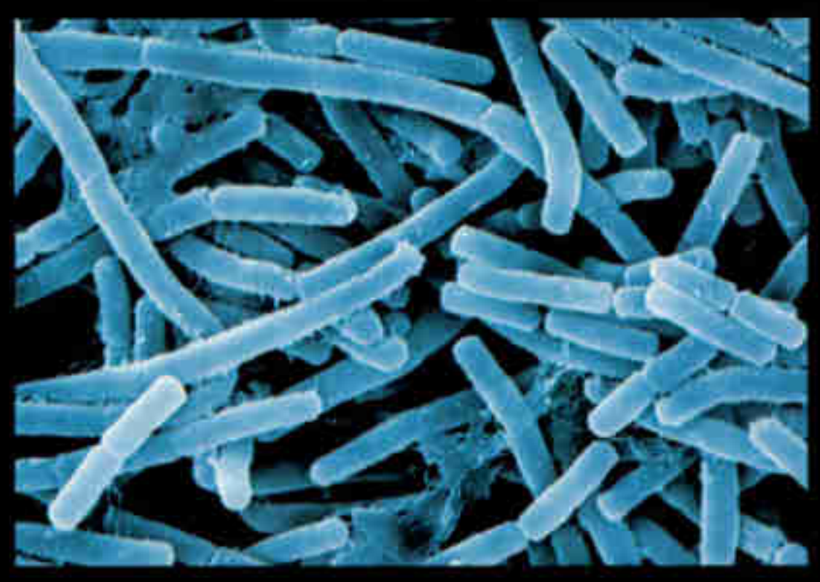
WHAT'S IN SKIN

Essential as brain and heart, the skin is the largest organ in the human body. It lies in three layers: epidermis, dermis, and subcutaneous fat. These integrated layers signal the brain to enact various physiological functions.

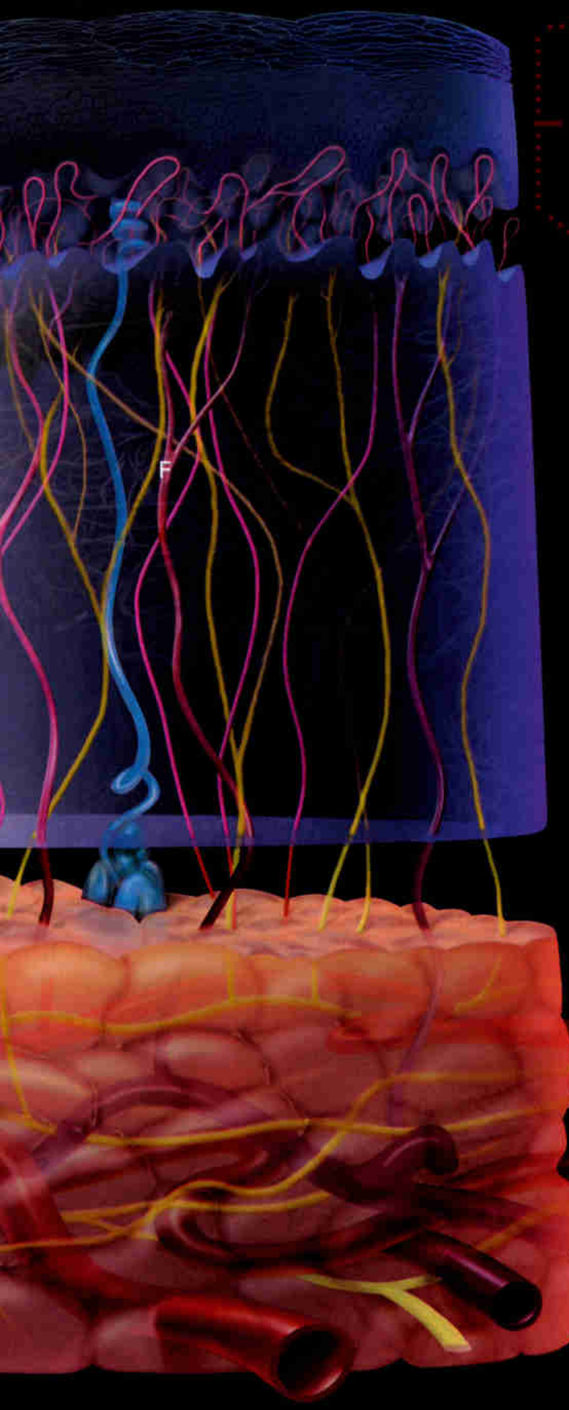
Among the skin's key players: Sebaceous, or oil, glands (A) lubricate skin and help retain water. Hair follicles (B) are shrouded in a network of nerves that sends sensory impulses to the brain and gives skin its exquisite sensitivity. Eccrine glands (C) produce sweat to cool the body, and apocrine glands (D) produce secretions that play a vital role in sexual attraction and reproduction. Pacinian corpuscles (E) are sensory nerves that relay tactile information to the brain's hypothalamus, which records temperature and pressure. Thin blood vessels, or capillaries (F), shuttle nutrients to the uppermost layers of the dermis and epidermis, carry off waste produced by cell metabolism, and help release body heat.

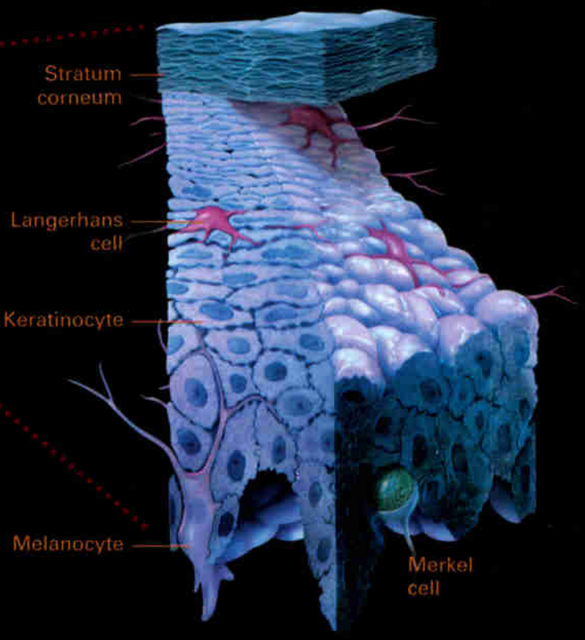
Magnified views from left to right: Acne bacteria, which live within the hair follicle, create acne in clogged oil glands. Langerhans cells, part of the immune system, attack cancerous cells as well as pathogens that manage to penetrate the skin. Beads of sweat form on the skin when it heats up from exercise, stress, or temperature changes.

ACNE BACTERIA



HAIR STRAND



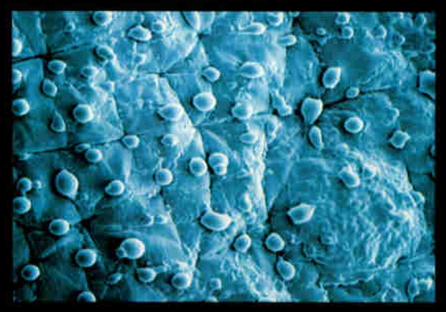


THE EPIDERMIS: FRONT LINE OF DEFENSE

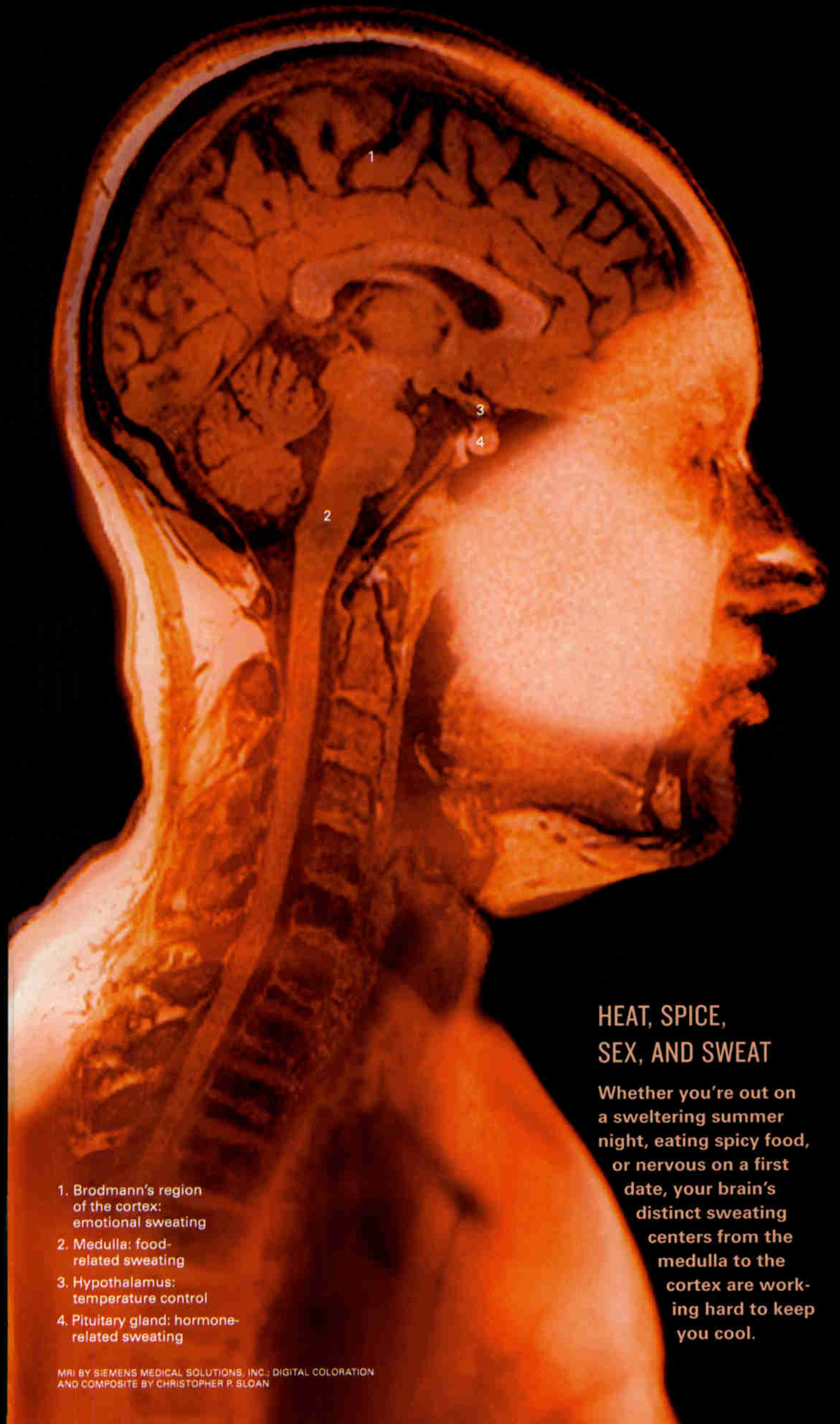
The outer layer of the epidermis, a protective covering called the stratum corneum, consists of 15 to 40 layers of flattened skin cells, or corneocytes, that have migrated up from deeper regions, fully replacing themselves about once a month. The corneocytes are filled with keratin and a fatty lipid that make a barrier to prevent the loss of water through skin. Beneath the stratum corneum lie keratinocytes, which produce keratin and form the building blocks of the epidermis. In the same area, Langerhans cells scout for invading pathogens while melanocytes produce the pigment melanin, which protects the skin from UV radiation. Merkel, or nerve, cells send messages via nerve receptors to the brain to register sensation.

LANGERHANS CELL

SWEAT BEADS



ART BY KEITH KASNOT. FALSE-COLOR SCANNING ELECTRON MICROGRAPHS (SEM) OF ACNE BACTERIA AND HAIR STRAND, DENNIS KUNKEL MICROSCOPY, INC.; LANGERHANS CELL SEM, KRISTIAN PFALLER, PATRIZIA STOITZNER, NIKOLAUS ROMANI, UNIVERSITY OF INNSBRUCK; SWEAT SEM, RICHARD WEHR, CUSTOM MEDICAL STOCK PHOTO



1. Brodmann's region of the cortex: emotional sweating
2. Medulla: food-related sweating
3. Hypothalamus: temperature control
4. Pituitary gland: hormone-related sweating

MRI BY SIEMENS MEDICAL SOLUTIONS, INC.; DIGITAL COLORATION AND COMPOSITE BY CHRISTOPHER P. SLOAN

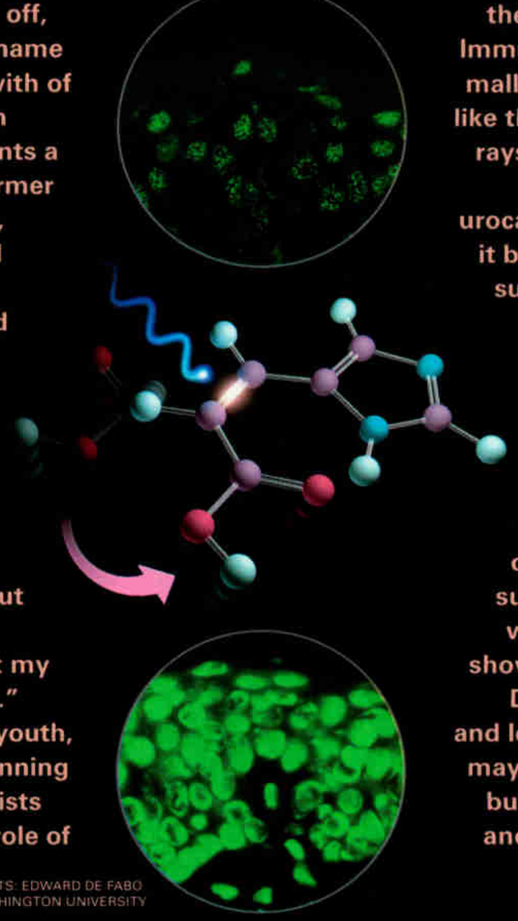
HEAT, SPICE, SEX, AND SWEAT

Whether you're out on a sweltering summer night, eating spicy food, or nervous on a first date, your brain's distinct sweating centers from the medulla to the cortex are working hard to keep you cool.

THE TROUBLE WITH TAN

"I've had 'em burned off, cut off, x-rayed, you name it," says Don Bennewith of his skin cancers. Each adhesive dot represents a removed lesion. A former lifeguard in Australia, Bennewith, 84, found his first skin cancer only 20 years ago and began a tally. "I lost count at 532," he says. "The worst are on the scalp. They had to peel it way back to get one, which took 64 stitches to heal up. But some good came of it when they brought my hairline forward a bit."

Since Bennewith's youth, when unprotected tanning was the norm, scientists have discovered the role of the skin's urocanic acid. Immune-system cells normally attack altered cells, like those damaged by UV rays. But when radiation strikes a molecule of urocanic acid (left center), it bends into a form that suppresses an immune response to the damage, a trait that may have evolved in our ancestors to give sun-damaged skin a chance to repair itself. With only minutes of exposure, skin cells stained with a fluorescent dye show signs of increasing DNA damage (left top and left bottom). The cells may repair such damage, but sometimes they fail and become cancerous.



ART BY KENNETH EWARD; CONSULTANTS: EDWARD DE FABO AND FRANCES NOONAN, GEORGE WASHINGTON UNIVERSITY

THE SCIENCE OF SUNBURN

Artfully applied zinc oxide protected a woman during visits to a tanning salon. The ointment blocked UV radiation; the unprotected skin darkened by increasing its amount of melanin, a natural sunblock produced in cells called melanocytes. Although all skin contains about the same number of melanocytes, the amount of melanin they produce varies. Light skin produces less, dark skin more.

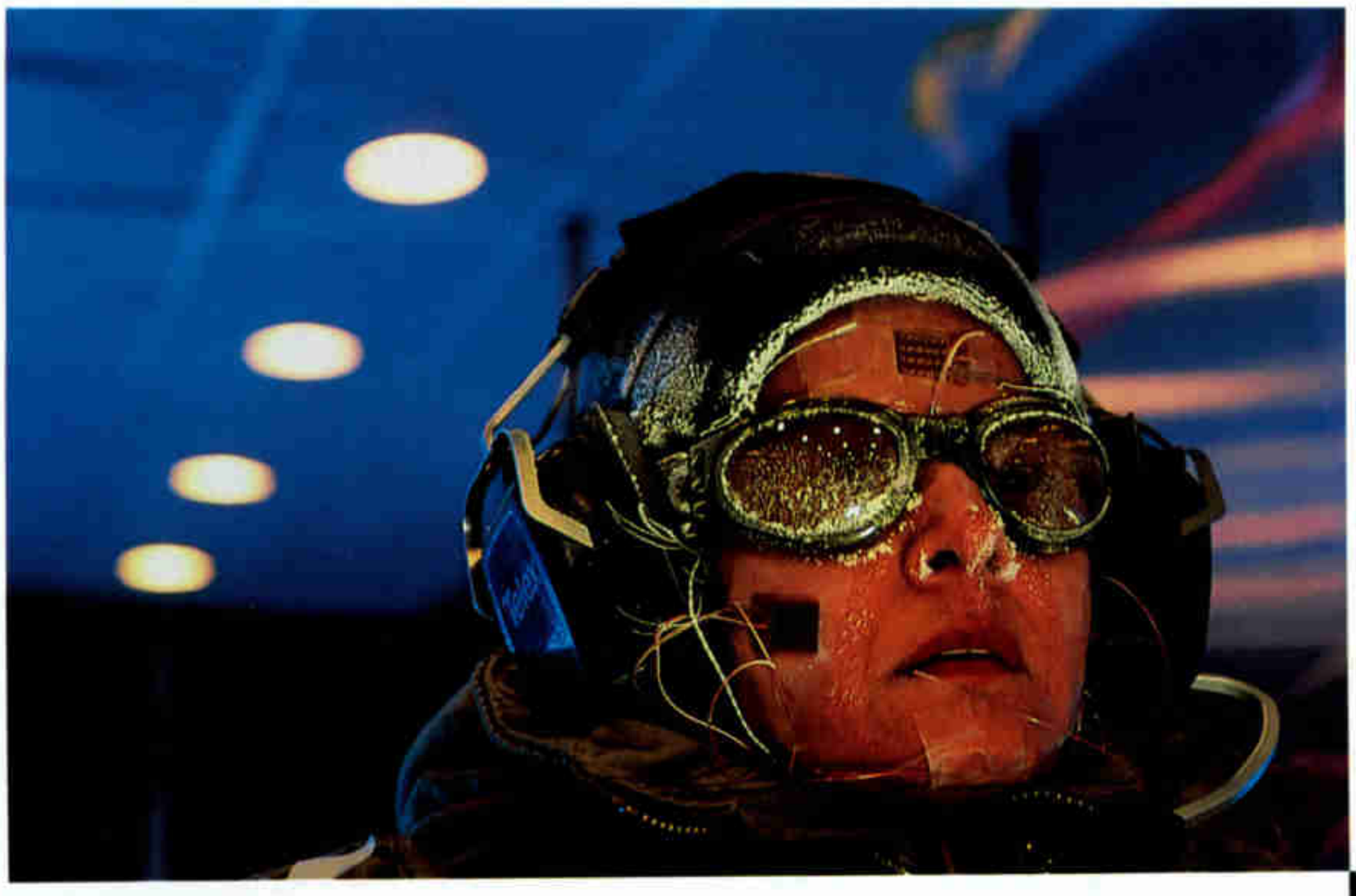
Scientists at the Food and Drug Administration and the National Cancer Institute are exploring the response of different skins to UV radiation (right) to discover how to optimize tanning with minimal radiation. Since melanin production continues for several days after exposure to sun, tanning more than two times a week may produce little additional pigmentation. With about a million Americans visiting tanning salons daily, FDA researcher Janusz Beer voices a warning: "There's no rapid tan, only more damage."

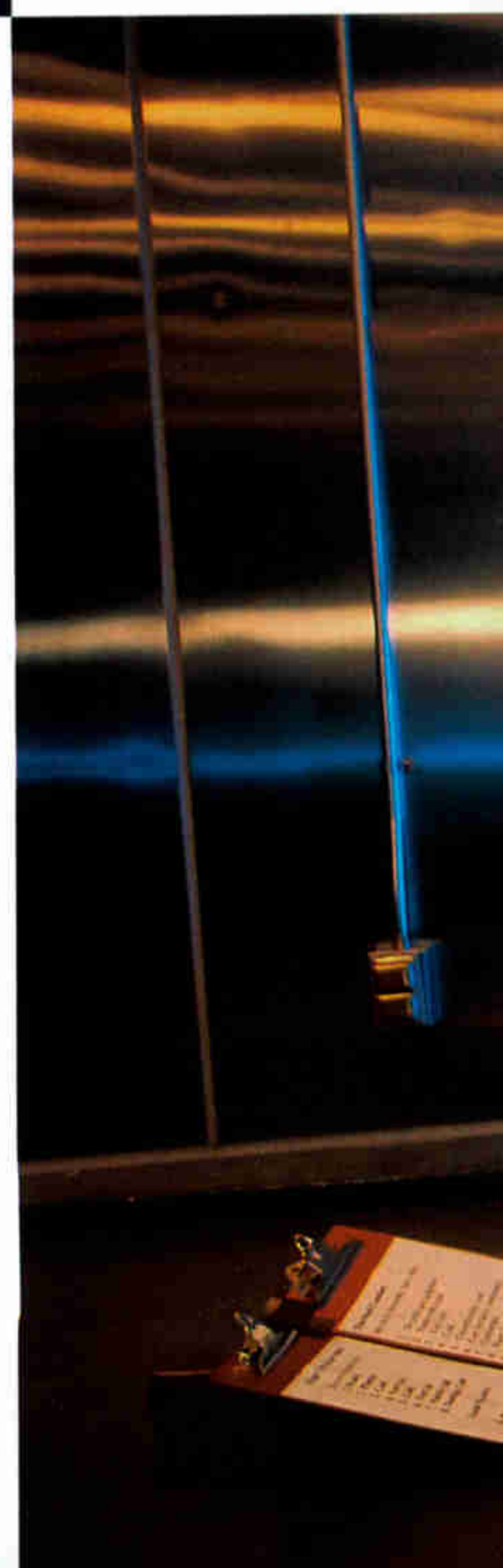
MINUTES IN THE SUN CAN LEAVE YOU DANGEROUSLY WELL DONE.

Researchers now know how quickly the sun does its damage. Scientists at the FDA have calculated the number of minutes it takes to produce a "minimal erythema dose"—the point where skin is burned enough to turn pink—in people with different skin types at the equivalent of noon on a summer day in Washington, D.C. The most sensitive pale skin burned after 14 minutes of exposure; the most resistant dark skin took more than seven times longer to burn. The numbers explain why light-skinned people living in Australia, where UV radiation levels are high, suffer high skin-cancer rates. They may also indicate why very dark-skinned people living in places like northern Europe, where sunlight is less intense, might suffer vitamin D deficiency: The large amount of melanin in their skin absorbs much of the available UV radiation that would otherwise make vitamin D.

ALL LAB IMAGES, PAGES 51-3, PROVIDED BY JANUSZ Z. BEER, FOOD AND DRUG ADMINISTRATION, AND VINCENT J. HEARING, NATIONAL CANCER INSTITUTE, WITH CONTRIBUTIONS BY SERGIO G. COELHO, JULIA A. KNISKERN, KATALIN S. KOROSSY, SHARON MILLER, TAKETSUGU TADOKORO, YUJI YAMAGUCHI, AND BARBARA ZMADZAKA

Draped in place over our bodies, skin forms the barrier between what's inside us and what's outside. It protects us from a multitude of external forces.





Both freeze-framed at minus 40° in 22-mile-an-hour wind, test subjects participate in experiments at Defence R&D Canada in Toronto. Researchers hope, by measuring skin reaction to a range of temperatures and wind speeds, to develop a formula that can predict how long it takes for skin to become frostbitten under a variety of weather conditions.

(Continued from page 46) many people of European descent deemed white skin desirable—it meant that its owner was a member of the upper class and did not have to work in the sun. Women even ate arsenic, risking illness and death, to make their skin pale. Among dark-skinned people in some parts of the world, skin whiteners and lighteners are still popular. A label on a product manufactured in Paris (which I purchased in Bangkok) claims to be "the first technology which regulates the different steps in the skin pigmentation process, to perfect the whitening efficiency." Those who cannot afford such products—or who want faster and more dramatic results—sometimes use illegally imported creams containing steroids or concoct their own abrasives.

Friends of mine in Indonesia have a daughter who just turned 16. As a coming-of-age gift her classmates gave her a skin whitening kit and a package of other whitening products, all designed for "the teenage skin." To be "fair," her friends told her, is to be desirable.

In other cultures during the 20th century, as cities grew and work moved indoors, perceptions about paleness shifted in the opposite direction. Tanned skin began to denote

leisure time, and fashion trendsetter Coco Chanel announced in 1929 that a "girl must be tanned."

By June 2000, with increased health warnings and rising melanoma rates, an article published in *Women's Wear Daily* insisted on the use of sunscreen because "It will be a cold day in hell before there's a shortage of bodies sun tanning on the beach, and this summer, a sun-roasted hide is more fashionable than ever."

TO LOOK TAN might be a fashion necessity, but to look young is just as desirable in many circles (even though the tanning process accelerates the aging of the skin). The fight against aging skin appears, when I look around the magazine stands in the supermarket, to have taken on the proportions of a war.

As we age, the skin loses its ability to retain moisture; the dermis loses its elasticity and its collagen stretches; and lines and wrinkles from laughter and other habitual facial expressions deepen.

To counter these effects, consumers worldwide spend several billion dollars a year on skin care products, not including cosmetics or services like facials. Most is spent by women, but marketers now target men, as well as girls as young as eight, encouraging them to try to prevent or diminish signs of aging. "Skin products can give everyone more confidence," one company executive explains.

My wife smiles when I start to bring home magazines filled with suggestions for various products and regimens: "Get Your Best Skin" and "Your Ideal Skin. See it. Feel it. Have it." I soon realize the cause for her amusement. They all basically say the same thing and have for years. To fight wrinkles, hydrate your skin. Wash well but not with harsh cleansers. Use absorbable antioxidants, such as vitamins A, C, and E, which may counteract

Jeramie Church, 14, suffers from xeroderma pigmentosum, a severe inability to withstand UV radiation. His suit, made from material designed by NASA, gives him some protection outside in daylight.

Perricone's recommendations coincide with guidelines for preventing heart disease and cancer. Maybe vanity can be an avenue to good health.

free-radical damage caused by the sun and natural aging. Toxins in cigarette smoke accelerate skin-cell aging.

But many people want more extensive results than such sensible measures afford. Americans now spend over 300 million dollars annually on the injection of botulinum toxin—produced during World War II by the U.S. biological weapons program—that temporarily paralyzes facial muscles to stop habitual movements, such as frowning, that contribute to lines and wrinkles. An estimated 1.6 million botulinum toxin (known as Botox) treatments were administered in the U.S. in 2001.

With such treatments, it seems to me, your face becomes less the story of your life and more the measure of your vanity and bank account, a step toward Aldous Huxley's *Brave New World,* in which faces remain "youthful and taut-skinned" throughout old age. When I telephone a prominent dermatologist to discuss skin diseases, the recording I hear while I wait on hold says: "Are you frustrated by crow's-feet and old wrinkle lines? Do you look at old photos? Please schedule a consultation."

Enough. I decide to experiment. Every day I'll treat the left half of my face with antiaging skin care products. The right side will receive nothing. I'll see if anyone notices a difference.

I choose Sisley, a pioneer in botanical products, and meet with representatives at the company laboratories just outside Paris. "Give it a month, and you'll see a difference in the half of your face that you treat," says one researcher. Company officials nod, their confidence built on studies documenting the effects on skin of oils and extracts from sage, cornflower, lily, horsetail, and apple seeds. They show me magnified before-and-after images in which ranges of wrinkles have been reduced to foothills.

After a month I abandon the experiment, although the treated half of my face looks marginally better (at least to me—no one else notices). I'd hoped for something more amazing. Besides, smearing three creams on my face twice a day takes a lot of time, and the creams feel cold.

I decide that although it's all right for me to try to look better, my wrinkles are not something to be cured. Wisdom, character, and experience should show on a face. I begin to see sense in the words of New York photographer Chester Higgins, whose images document the beauty in older faces. Higgins sometimes walks up to women and offers a compliment: "I love your crow's-feet."

My complacency disappears when I pick up *The Wrinkle Cure* and *The Perricone Prescription,* both by Nicholas Perricone, a dermatologist and professor of medicine

"Touch is a basic and powerful necessity," says massage therapist Beth Cosmos, working with a premature baby (opposite). Preemies who are touched and held show faster progress. In a Bangkok hospital, acupuncture and herbal treatments are believed to help fight various ailments, including paralysis.

at Michigan State University's College of Human Medicine. I do another about-face. Perricone argues that you can make your skin more healthy and keep it from aging by changing diet, taking the right supplements and vitamins, increasing exercise, and drinking lots of water.

Perricone's recommendations coincide with guidelines for preventing heart disease and cancer. Maybe vanity can be an avenue to good health.

A spa client undergoes a seaweed treatment supposed to draw out toxins and replace nutrients in her skin. Hoping to halt frown lines and crow's-feet, thirtysomething Kelly Curtis prepares for a needle full of muscle-paralyzing Botox (botulinum toxin), the latest craze for aging skin. "I'd recommend it to all my friends," says Curtis.

My interview with Perricone takes place at the St. Regis Hotel in New York City. As we sit down together I ask him what stimulated his interest in skin. He shows me the discolored lines in his hands, evidence of the eczema that has plagued him since his teens.

Afternoon tea arrives, complete with multi-tiered plates of sandwiches and cookies filled with the carbohydrates and sugars Perricone advises people not to eat because they raise blood sugar levels, triggering, he says, inflammation that contributes to problems ranging from heart disease to wrinkling. For three hours we converse over this food, which neither of us touches.

"Look behind you," Perricone says at one point. He's indicating an elegant woman with a flawless face. "She's pretty, but she's had a face-lift. It's not natural, so it's not attractive," he says. "Her face muscles are all flat. She could have made changes in her diet to lift and tone her face muscles naturally."

Perricone is 54 years old, but he looks a lot younger. So for the next 72 hours I do what he recommends. I drink ten glasses of water a day and, twice

MORE ON OUR WEBSITE

For an online interview with Sarah Leen, field tales about life on assignment, and a listing of websites and resources go to **nationalgeographic.com/ngm/0211.**

a day, eat salmon, which is high in omega-3 fatty acid, a powerful antioxidant.

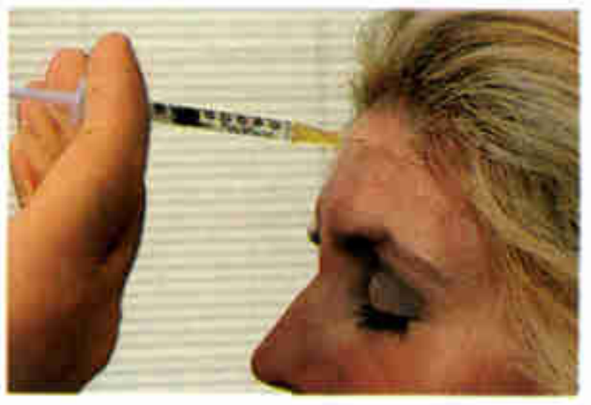
After three days I'm not sure how much more salmon I can eat, and I understand why some people tell Perricone that they'd rather smear the salmon on their face than continue with his program. But I feel great, and my face looks firmer and more alive, with better color.

Having seen the effects of aging arrested by diet, injection, and surgery, I decide that my next stop will be a nursing home, where I can investigate the results of aging allowed to take its natural course. I'm thinking mostly about wrinkles, but a phone call from my sister brings me back to where the life cycle of skin begins—the sense of touch.

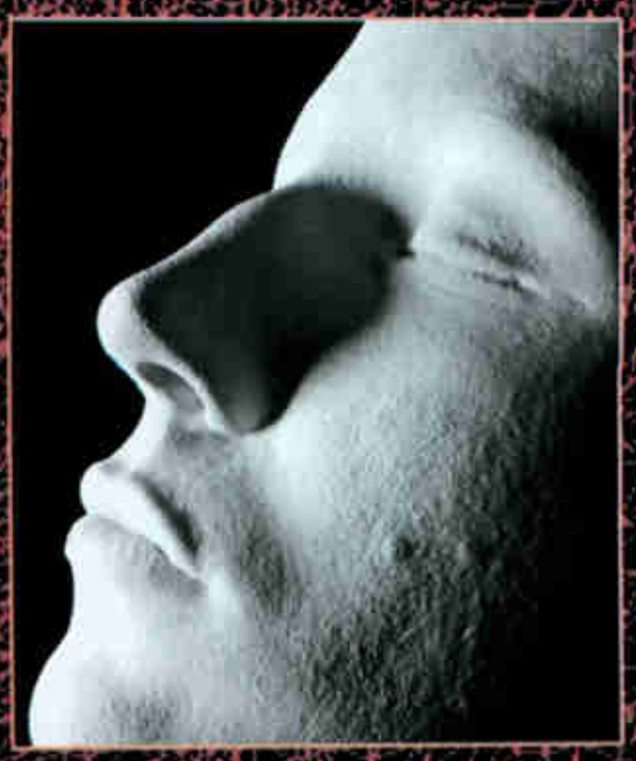
Our mother, who is 86 years old and in poor health, has collapsed. When I walk into her hospital room, I lay my cheek on hers and lift her fingers into the palm of my hand. Although one of her eyes is partly open, the doctor says that she may not be able to see or hear me.

I try to comfort her by talking, singing songs from my childhood, or just sitting quietly. I'm not sure what she can sense, but her skin feels warm and normal. I keep my fingers on her arm or cheek, anything to let her know that she is not alone and that she is loved. I realize that our only unbroken connection now is through touch. We are skin to skin, warmth to warmth. According to the textbooks, transduction within the skin is transforming physical energy to neural energy. But something far more important is occurring. Love and memory are flowing through my skin and into her dreams.

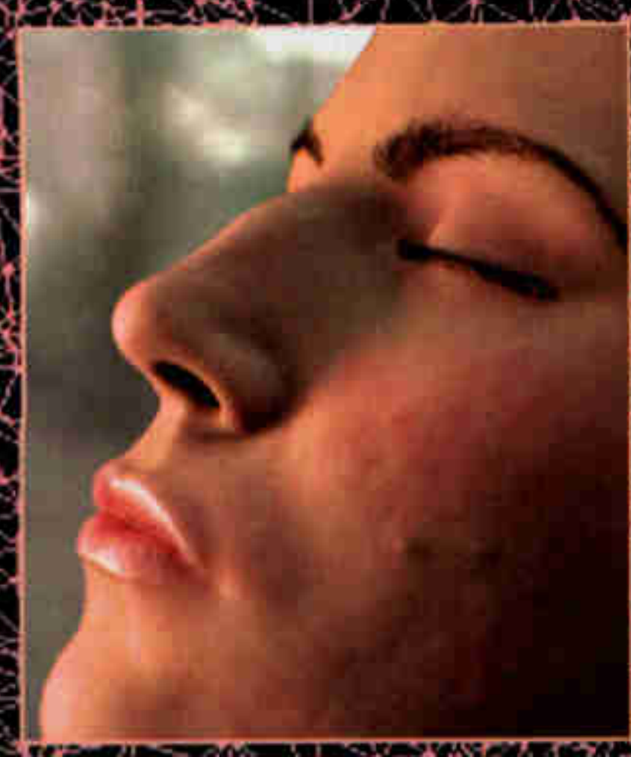
Americans spend over 300 million dollars annually on injection of botulinum toxin—produced during World War II by the U.S. biological weapons program.



VIRTUAL SKIN:
Making the Unreal Real



Computer software designers proved just how closely they can mimic human expressions in the film *Shrek*, but they'll capture the holy grail of animation when they can bring virtual skin to life. That day may not be far off. After photographing a model's face (right top), designers made a mask. Then they created a digital scan of the mask at maximum resolution to create an image comprised of 13 million polygons (second frame). Flesh tones appear in the third frame and oily areas that reflect light, as real skin does, in a black fourth version. Finally in frame five: the cyberface of the future, a complex digital rendition of light interacting with skin. Someday animation will make a face like this move as if it were the real thing.



This high-resolution 3-D scan represents the most accurately reproduced skin ever displayed on a computer. Part of the base layer, a mesh of triangles from the area around the nose and mouth, forms the backdrop for the page at left.

When light enters real skin, it scatters among the translucent cells just beneath the surface, giving the skin a soft glow. Imperfections—the patterns of oils and irregularities on the surface—contribute to skin's textured appearance. Computer-graphics experts can replicate these effects digitally (above). The next step will be to produce virtual actors who can appear in scenes too dangerous or otherworldly for real people, or even to resurrect the movie stars of yesteryear. The medical industry eagerly awaits virtual-reality flesh so that surgeons can practice on virtual human bodies. □

COMPUTER GENERATED IMAGES COURTESY DR. HENRIK WANN JENSEN, COMPUTER GRAPHICS LABORATORY, STANFORD UNIVERSITY; 3-D MODEL (OPPOSITE) BY ARIUS 3D, INC.; *SHREK* IMAGE: DREAMWORKS SKG, LLC

NATIONAL GEOGRAPHIC RESEARCH AND EXPLORATION

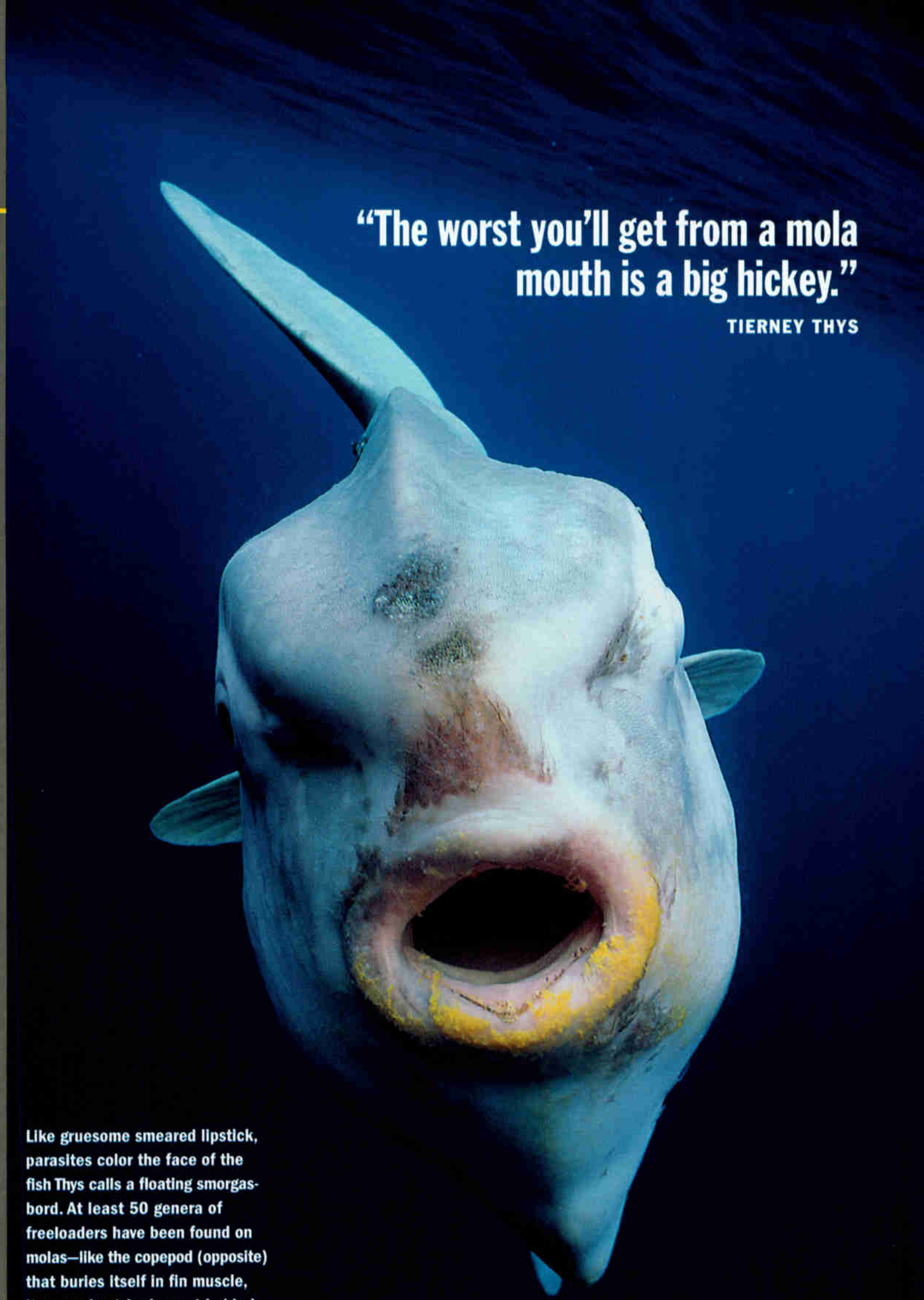
GRANTEE
Tierney Thys
Marine Biologist
Monterey, California

"The mola is Mother Nature at her most wild and whimsical. It shows just how far she can push a design and still call the outcome a fish."

It's a gigantic swimming head
Its skin is like sandpaper
It's covered in parasites

It's a Mola

A fish with a fore but no aft, stiff-bodied *Mola mola* hangs solo beneath a kelp patty off San Diego. "Working with such a short deck of cards, it's done quite well for itself," says Thys.



"The worst you'll get from a mola mouth is a big hickey."

TIERNEY THYS

Like gruesome smeared lipstick, parasites color the face of the fish Thys calls a floating smorgasbord. At least 50 genera of freeloaders have been found on molas—like the copepod (opposite) that buries itself in fin muscle, its gonads stringing out behind. "Mola parasites are wild," says Thys, who saves specimens for study. "They're like little aliens."

By Jennifer Steinberg
NATIONAL GEOGRAPHIC WRITER

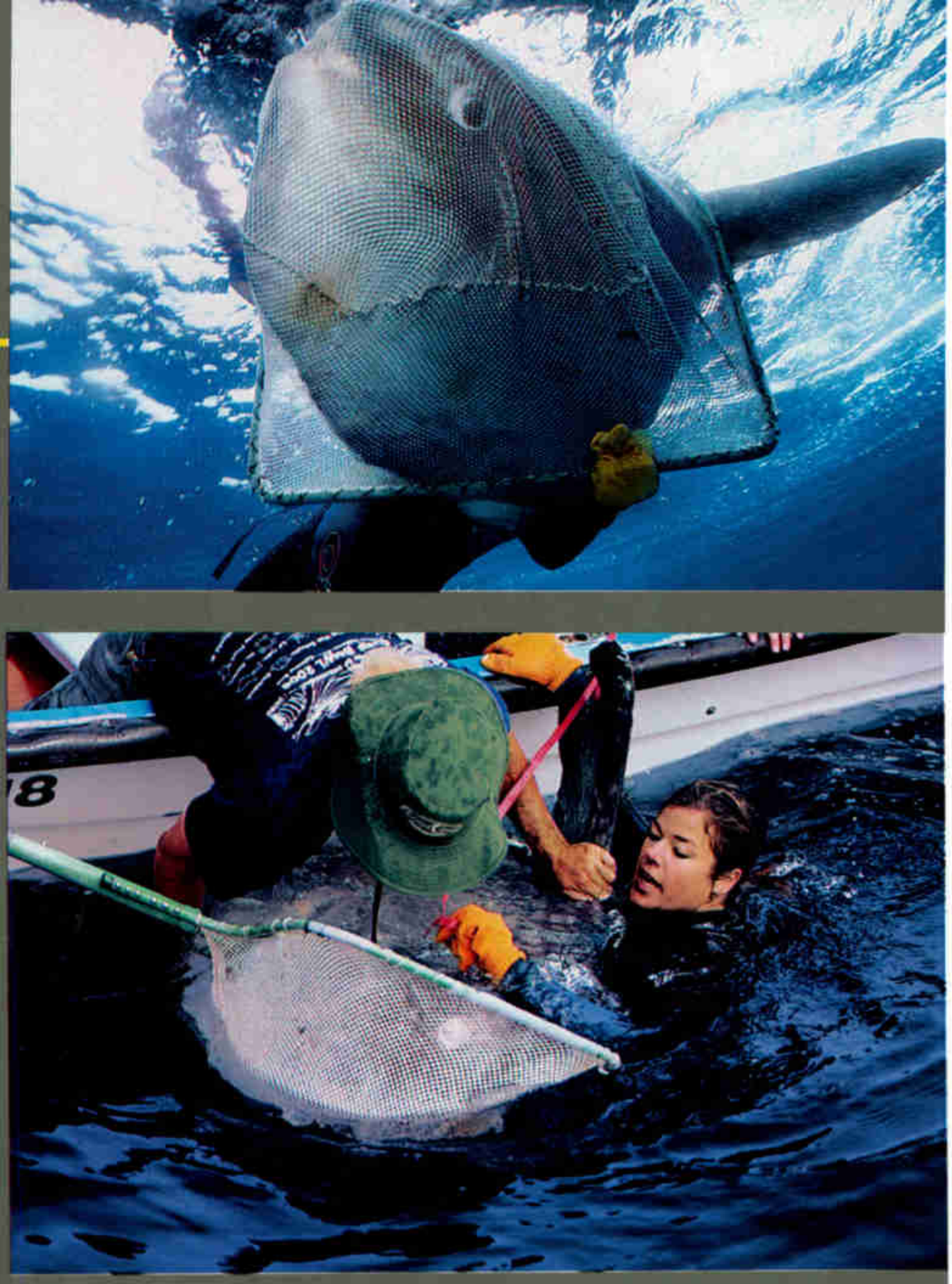
Photographs by Mike Johnson

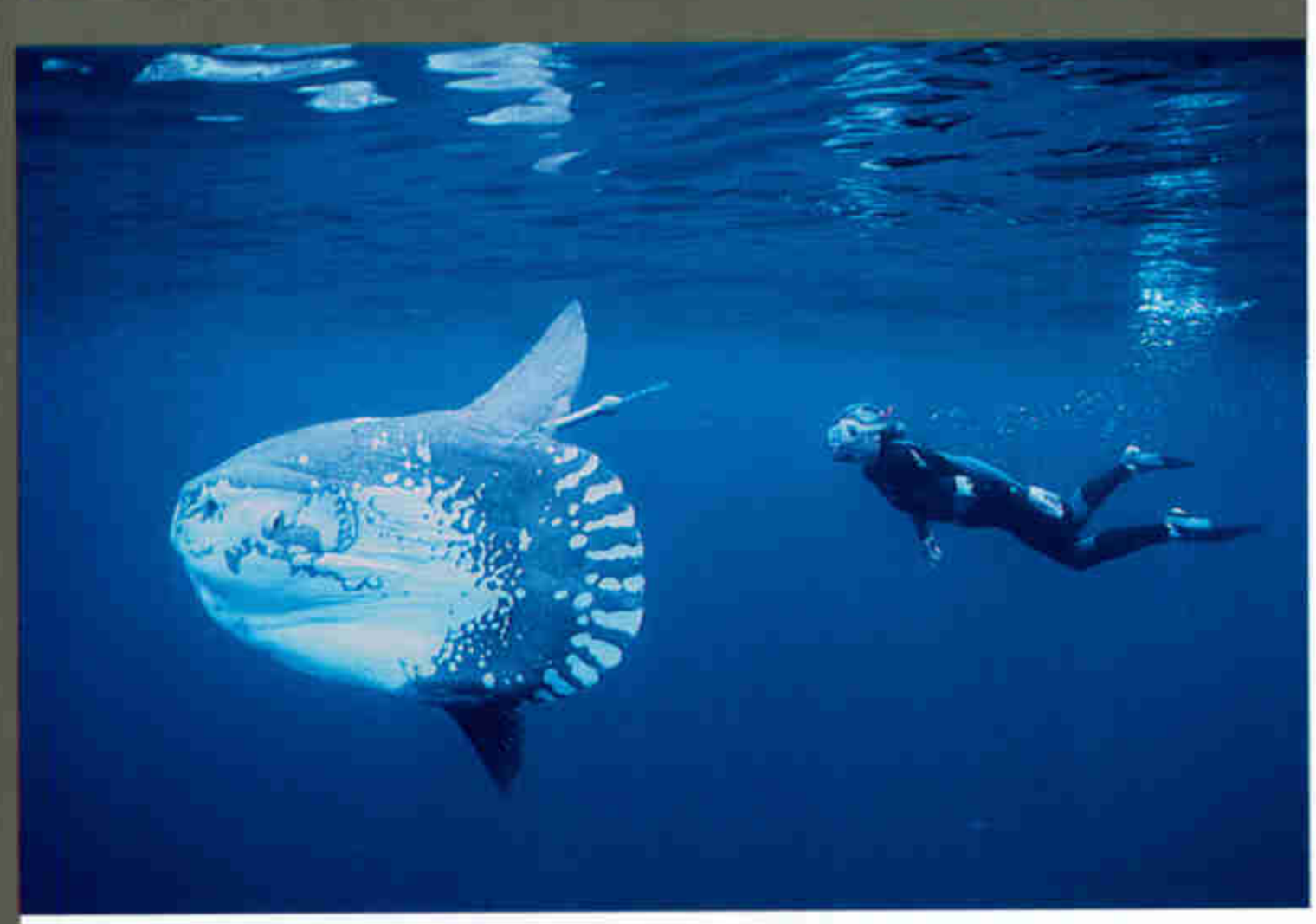
Windblown and salt sprayed, biologists motoring off the California coast squint against the glare in search of kelp patties below the sea surface. It's not the floating algal masses they're after, but the natural wonder that lurks beneath—a giant pancake of a fish: the mola. "There!" The pilot points starboard, and the team leaps into action. Within an hour, its cover blown, a petite 150-pounder is snagged, tagged, and released by Tierney Thys, a woman delighted with the task.

Add "ich" to her surname and you get *ichthys* (Greek for "fish"), appropriate for a marine biologist who, if you ask, will wax poetic about her subjects. Thys (a Belgian name she pronounces "teece") has been following molas around since she became fascinated by fish biomechanics in 1991. She and colleagues worldwide are now collecting skin samples and tagging these little-known animals—relatives of reef-loving puffer fish—for satellite tracking, studying their movements, distribution, and genetics. They hope, in part, to learn how molas—or ocean sunfish—are affected by fisheries, both as catch and bycatch. "That depends greatly on whether this is one huge population or many different stocks," says Stephen Karl, who is doing the DNA work. The number of species is also in question. Three are known; genetic studies suggest more.

The "swimming head," as some call the mola, took to the open seas some 50 million years ago. It now moves about quietly in most of the world's oceans—far enough out that sightings are rare. On a diet mainly of jellyfish, the mola somehow explodes in size: It can top 4,000 pounds. In turn, molas are munched by sharks and sea lions—the latter snatching up juveniles, ripping off the fins, and tossing them like grisly Frisbees before wolfing them down. (Waiting out a game got Thys a mangled baby mola for her dissection studies. "It now rests in my freezer between veggie burgers and frozen peas," she says.)

Unlike her colossal, shy subjects, Thys is compact and uninhibited, a woman in constant





"They look bewildered, as if in disbelief of their own bodies," Thys says. To tag a 150-pound youngster, she helps a colleague net it (top) and steer it to the boat to measure it (center), tag it, and snip a bit of gritty skin for genetic tests. On release, each fish is observed, then bid adieu. "They really scrape you up," says Thys, who emerged bloodied from her first embraces. Usually spied basking on their sides (opposite), molas in fact can dive to frigid waters below 1,900 feet to feed—sometimes 20 times a day. "That was the first surprise revealed by our tag data," she says. More to come.

THE PROJECT

MOLA RANGE: ALL TROPICAL AND TEMPERATE OCEANS
TAGGED SINCE 2000: 16 MOLAS OFF JAPAN, TAIWAN, SOUTH AFRICA, AUSTRALIA, AND THE U.S.
RESEARCH INTERESTS: GENETICS, DISTRIBUTION, HABITS, THREATS
WORK'S BIGGEST REWARD: WORLDWIDE COLLABORATION WITH "KINDRED MOLA FANS"

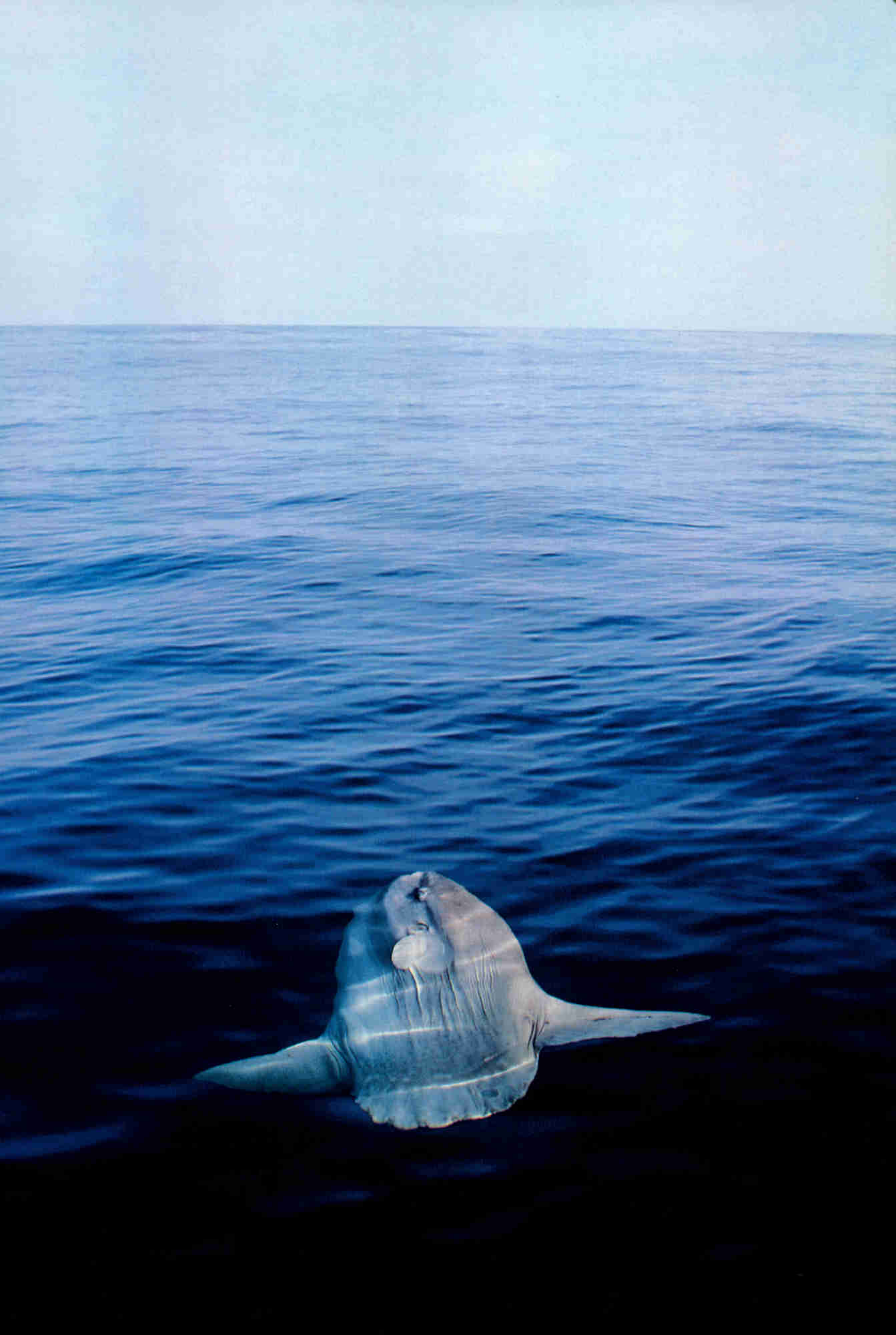
mental and physical motion. "She's an exuberant spirit," says colleague Heidi Dewar. "An enthusiasm for molas permeates everything she does. And a sense of fun: She travels with a couple of wigs, just to shake things up."

"She appreciates the complexities of even the lowliest creatures," says photographer and collaborator Mike Johnson. "Give Tierney a bucket of worms and she's as happy as a kid with a new bike." And her love of nature's oddities, it seems, is contagious—and spreading quickly. According to Stephen Karl, Thys is "a master collaborator. She makes it all happen." Indeed, researchers in 15 countries have joined the cause, focusing efforts and funds on getting to know the mola.

The first satellite studies are just in, and scientists hope to raise money for more tags in the coming months. "This fish has a story to tell," Thys says. "Let's hear it." □

MORE ON OUR WEBSITE

Want to learn more about the mysterious mola? Find recommended websites and a bibliography at **nationalgeographic.com/ngm/0211.**



CHALLENGES FOR HUMANITY

Where's everybody going?

Images from Hyderabad, Bangkok, Lagos, and São Paulo (preceding pages) form a collage of life in some of the world's biggest cities. São Paulo (below), with 18 million people the largest of the four, stretches for more than 3,000 square miles, from its high-rise downtown to its ever expanding tin-and-wood outskirts.

Cities

Irresistible lure for dreamers, doers, and the desperate, urban areas will soon hold half the world's people. How they adapt will help define the 21st century.

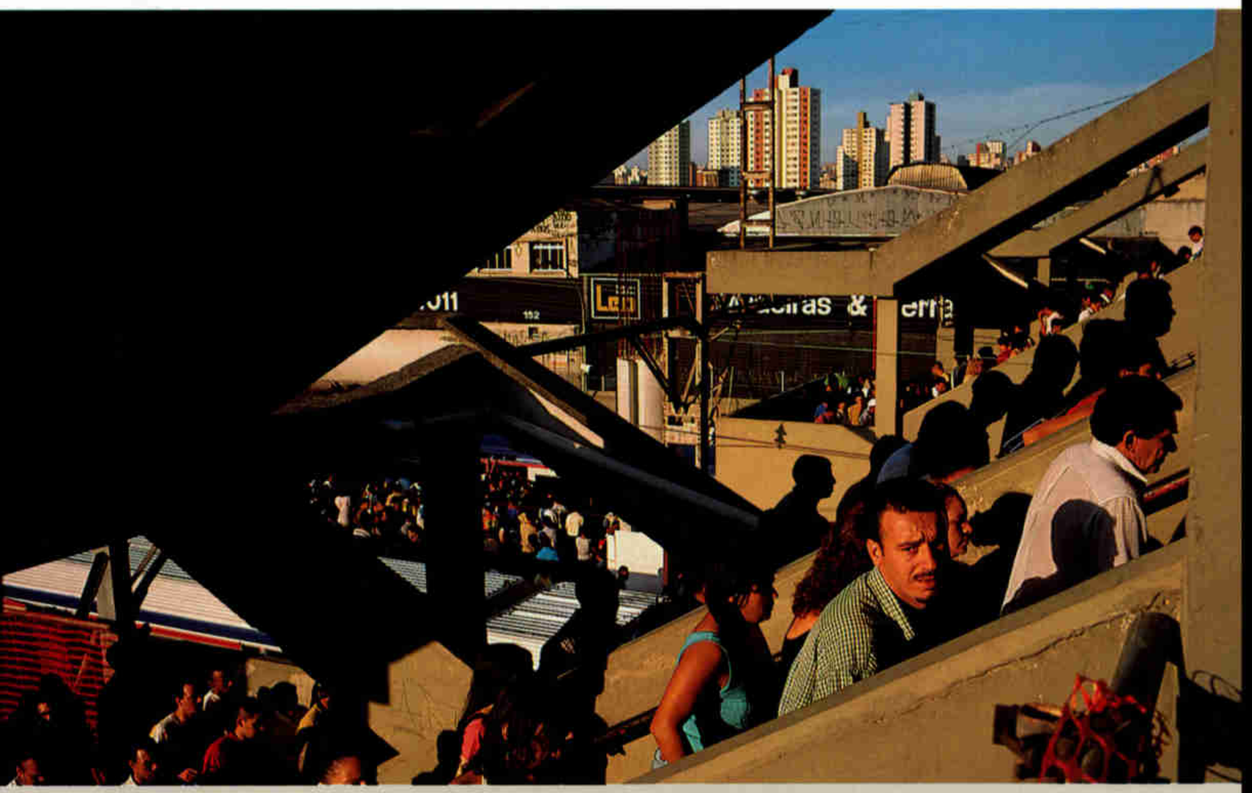

Itaú

Urban Explosion

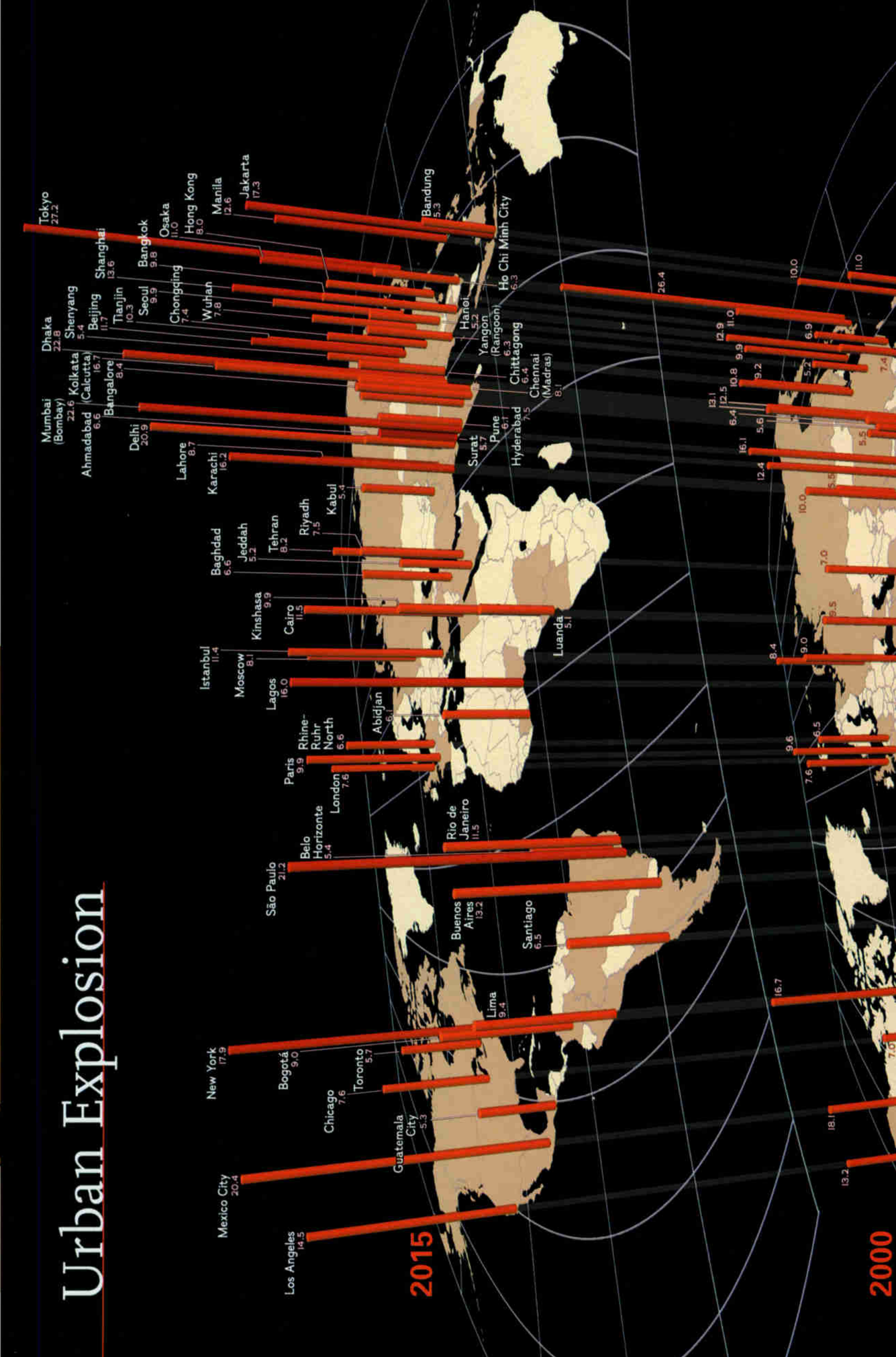
By Erla Zwingle Photographs by Stuart Franklin

There once was a time when big cities thrilled and amazed people. "It is the metropolis of the universe, the garden of the world," Ibn Khaldun, the Arab historian, wrote of Cairo in 1382. English traveler Thomas Coryat described Renaissance Venice as a "beautiful queene." French artist Marcel Duchamp, in 1915, called New York City "a complete work of art." Since their appearance about 3000 B.C., cities have always been the natural center of everything that mattered: the temple, the court, the market, the university. And for anyone with a particle of ambition, there is little choice. Shakespeare left Stratford to go to London, after all; not the reverse.

Of course, your own city may not immediately inspire words like "peerless" or "paradise." Even though cities have been the fountains of civilization, many thinkers, from Rousseau to Jefferson to Thoreau, have regarded cities as the



URBAN INFLUX Commuters exiting trains from São Paulo's poor fringe climb stairs to a subway that will take them to jobs in the city center. For all their problems—traffic, pollution, high cost of living, slums, crime—cities provide people in the developing world the best hope of education and income.



Urban Explosion

1950

NORTH AMERICA

SOUTH AMERICA

EUROPE

ASIA

AFRICA

AUSTRALIA

6.8

7.4

18.0

12.0

10.7

5.5

8.7

5.1

New York
12.3

London
8.7

Paris
5.4

Rhine-Ruhr North
5.3

Moscow
5.4

Tokyo
6.9

Shanghai
5.3

Buenos Aires
5.0

BURGEONING BIG CITIES

Country with at least one city of five million or more residents

Country without a city of five million or more residents

Tokyo
27.2 Population in millions

Cities with populations of five million or more

Present-day boundaries shown

SOURCE: U.N. POPULATION DIVISION

NATIONAL GEOGRAPHIC MAPS

NEW WORLD ORDER In 1950 there was just one city with a population of more than ten million—New York. In 2015 there will be 21, and the number of urban areas with populations between five and ten million will shoot from 7 to 37. This growth will occur mainly in developing countries, those least equipped to provide transportation, housing, water, and sewers. Asia and Africa, now more than two-thirds rural, will be half urban by 2025. Never have urban populations expanded so fast. "Humanity has not been down this road before," write urbanists Peter Hall and Ulrich Pfeiffer. "There are no precedents, no guideposts."

Worldwide, cities gain a million people a week.

source of corruption and evil. The universal myths of earliest Edens are always set in the country; the city is what happens after sin sets in.

However urban life strikes you, cities worldwide have been growing ever more rapidly. Some of this growth has occurred in the developed world—Las Vegas, for example, grew by 83 percent in the nineties. But the most dramatic increase has been in the Third World. Almost all the world's population growth over the next 30 years will take place in the cities of developing countries. By the year 2030, for the first time in history, 60 percent of the world's people will be living in cities.

This is actually good news in some ways. "Cities are the fundamental building blocks of prosperity," says Marc Weiss, chairman of the Prague Institute for Global Urban Development, "both for the nation and for families." Industrial and commercial activities in urban areas account for between 50 and 80 percent of the gross domestic product (GDP) in most countries of the world. "There's the crazy notion that the way to deal with a city's problems is to keep people out of them," Weiss continued. "But the problems of rural life are even more serious than those of the city." For better or worse, urban-watchers are clear on one point: The quality of life for most people in the future will be determined by the quality of cities.

Those cities will be bigger than ever. A megacity has more than ten million inhabitants. In 1995 there were 14; in 2015 there will be 21. And the ranking will have shifted: Today the five largest cities are Tokyo, Mexico City, São Paulo, New York City, and Mumbai (Bombay), and in 2015 they will probably be Tokyo, Dhaka, Mumbai, São Paulo, and Delhi.

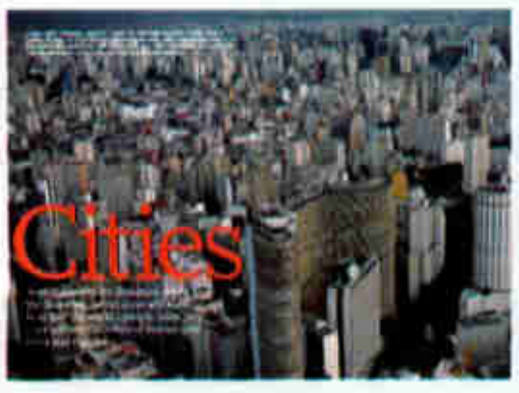
And yet, population numbers by themselves don't determine a city's prospects; after all, Addis Ababa, Ethiopia, and Hamburg, Germany, have the same population. Nor is explosive growth necessarily the determining factor. "City problems," one authority points out, "mostly have to do with weak, ineffective, and usually unrepresentative city governments."

None of this is inevitable. Lest we imagine that slums and misery are somehow the fate of the Third World, it's worth recalling the horrific lower depths of London, Paris, and New York that inspired the great social movements of the 19th and 20th centuries, and the crusading zeal of novelists Charles Dickens and Victor Hugo and photographer Jacob Riis against the festering tenements, sweatshops, and child labor that blighted these cities, now among the First World's proudest metropolises. Solutions have been found before.

To discover how people are coping with drastic urban growth, photographer Stuart Franklin and I went to São Paulo, Bangkok, Lagos, and Hyderabad. I was prepared to be overwhelmed, and I was. But it wasn't the shapeless turmoil, the choking air, the crushing slums and mindless skyscrapers and fetid streams that left the deepest impression. It was the people, so tenacious, gallant, ingenious, and hopeful. These massive cities are not, as they may first appear, overloaded freighters with no rudder and a large hole in the hull. In the anonymous stretches of city peripheries and the deepest pockets of teeming old quarters, I found that what appeared to be each city's greatest burden—all those people—is in fact her richest resource. How to make it work is the problem.

Challenges for Humanity LAST IN A SERIES

Over the past year NATIONAL GEOGRAPHIC has explored some of the major challenges of the 21st century. How can the world control disease? Keep its food safe? Protect the water supply? This final installment investigates the failures and successes of some of the world's largest cities.



São Paulo, Brazil

World's Third Largest City

A hundred years ago São Paulo was home to some 265,000 people; today there are 18 million, nearly half of whom weren't born there. Although the peak growth years are past, when the construction boom of the seventies drew people from all over Brazil, economists still call it the "locomotive of Brazil." Not only do her people, the Paulistanos, produce—from banking to automotive to petrochemical products—they are the largest consumer market of all Latin America.

"But there is always the feeling that São Paulo is not Brazil," said Luciana "Luli" Artacho Penna, a young graphic artist, at dinner one night. "It's very ugly; it's very expensive."

It's true that the world thinks of Brazil as Rio de Janeiro, the alluring city of beaches and babes 250 miles to the northeast. São Paulo is a gray infinity of concrete, steel, and corrugated tin speckled with countless small red-dirt soccer fields. It stretches across vast undulating hills—20 percent of the entire city is now composed of favelas, or slums—with wild clusters of skyscrapers that seem to shoot up at random. There are some pockets of neighborhoods with distinguishable personality—the elegant Jardins area, the Beverly Hills of São Paulo, or Vila Madalena, a good candidate for a Brazilian Greenwich Village, and some others—but mainly São Paulo seemed to be just more streets and buildings than I could even imagine. In the rich neighborhoods the houses are hidden behind fortress-like walls, and the streets are empty. The favelas are either banished far out on the fringes, or huddled literally in the shadow of expensive high-rise apartments. Still, Paulistanos stubbornly defend their urban behemoth. "We don't really believe it's so ugly," Luli admitted, "but it's very difficult to speak about São Paulo, why we love it. I couldn't live anywhere else."

BUYER'S MARKET Stacks of 20-cent dish towels, fresh-sliced melon, and more compete for the cash of workers heading home in São Paulo. Street vending provides jobs and delivers goods at bargain, or "banana," prices. But vendors clog streets and seldom pay the city taxes.

About two-thirds of São Paulo's people live in poverty, but the

The largest pool in São Paulo draws working-class Paulistanos—but not the city's affluent. "You would never see a rich person here," says a city resident. Terrified of crime, the wealthy live in walled, gated enclaves protected by armed guards.

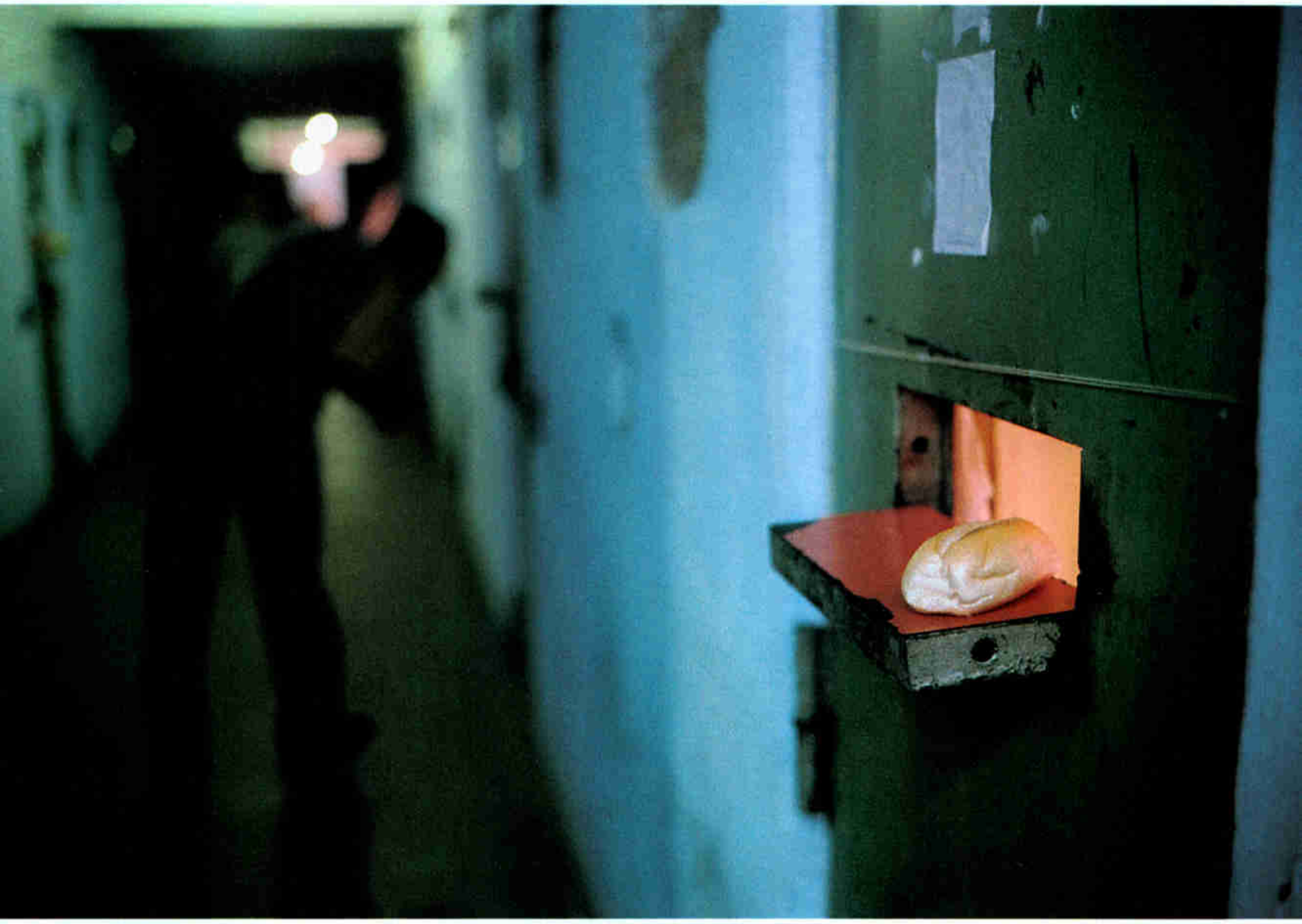
city is so segregated the rich never need see the poor.

For rich and poor alike, daily life focuses on traffic, crime, and housing, three issues that highlight ways growth has gone wrong here.

"Traffic: It's a nasty future," said Jorge Wilheim, secretary of urban planning. "There are 30 million daily trips in São Paulo. One-third is public transport, one-third is private cars, and one-third is walking. It should be 60 to 70 percent on public transportation. It reflects a very bad situation." A new beltway to siphon off truck traffic is under construction, and the subway is being extended, but it's slow work; they are only building six miles of subway a year. So millions are outside in the traffic jams. The rich are flying: São Paulo has the second largest private helicopter fleet in the world.

One of the fundamental solutions to the traffic here, and in many other cities, is to shorten the distance people must travel between home and work. Today there are fewer than ten jobs per acre in the city's periphery, while in the center of the city there are 80 per acre. Yet the center contains roughly 400,000 empty houses or apartments. The owners want to rent them at prices the poor can't afford, which means that several million people are compelled to live in cheap housing miles away from their work and must travel for hours every day, aggravating traffic, pollution, and stress.

Most cities have master plans to guide development, but rapid growth shows their flaws. "People say the city wasn't planned," says Raquel Rolnik, a professor of urbanism at the



MEAN STREETS **São Paulo's military police patrol a favela, or slum, with guns drawn (upper left). Many slum dwellers agree with political conservatives that force is the only way to deal with crime in São Paulo, where thousands are murdered every year. But the police's shoot-first approach cost them public support in 1992 when they killed 111 inmates during an uprising at Carandiru Prison (left)—apparently after prisoners surrendered. For a reprieve from worries over crime and unemployment, residents of the Jardim Ângela favela (above) sip beer at a barbecue.**

Pontifical Catholic University of Campinas. "This is not true. The city has plans, but they were plans that produced these problems." In São Paulo, as in many other cities in the world, the center was gradually abandoned by the rich who moved to leafy enclaves farther out. But the urban plan decreed that the poor be pushed even farther beyond, into immense swaths along the city's ever expanding edges. The current master plan proposes bringing middle class and poor people nearer to the downtown area, as well as upgrading districts on the periphery by adding public institutions, parks, and sport and cultural centers. The idea is that by mixing land use, the social classes will begin to interact again in a more natural way, sharing their city instead of balkanizing it.

After all, the separation of rich and poor has reflected and intensified social stresses. In São Paulo the rich are often unfathomably rich, and the poor are disastrously poor. Crime and violence flourish anyplace where jobs are few, youth are many, and the chasm between rich and poor becomes too deep and too obvious—all true in São Paulo. Brazil is the 11th largest economy in the world, but the United Nations ranks it 69th on the Human Development Index, a scale measuring social well-being by quantifying longevity, education, and standard of living. The rich live in fear: Brazil now leads the world in the number of armored cars, and most of them are in São Paulo. There is at least one armed hijacking a day. "It's so common that they don't even tell the police," my interpreter, Paulo Alves, remarked. Of course the poor live in fear too; São Paulo's high rate of homicides (9,000 in 1999, compared with fewer than 700 in New York City) reflects slum violence and gang conflicts related to drug dealing. Rich and poor are each isolated in their

Nearly half of São Paulo's 18 million people weren't born there.

own ghettos, the rich barricaded behind walls, with private security guards, and the poor in the favelas staying indoors all night to the sound of gunfire.

Somewhere at the point where hope and struggle meet you'll find Ilson da Silva. He lives on the slope of a now closed garbage dump in the municipality of São Bernardo do Campo. You wouldn't usually think of landfills as residential areas, but in the developing world any open space is fair game for improvised housing. The names and forms vary—in Brazil they're called favelas, in India, *bastis,* elsewhere, slums or shantytowns—but they're everywhere, in fields, under overpasses, and here, in the old dump. People find spare land and just start building.

"In most of Latin America, Africa, and Asia the cities are basically being built by lower income people," said David Satterthwaite, of the International Institute for Environment and Development in London. "If people aren't evicted, and if the government can get water and sanitation to them, they quickly develop the slums into regular neighborhoods." Ilson is a perfect example of this: He built his little house himself out of bits he scavenged from the garbage.

Ilson is still single and living alone, both unusual here for a man in his late 20s. But like many of the urban poor, he works. Ilson has a job as a porter in three buildings downtown, for which he earns 380 reals ($130) a month. He had made a good start a few years ago selling the bread he made in his sister-in-law's kitchen. But demand outstripped his equipment, and he had no money to buy a bigger oven or rent a place to install it, so he had to give up his dream of becoming a baker.

He has smooth, dark skin and a quick, engaging smile, and the day I met him he was wearing the most brilliantly white cotton T-shirt I'd ever seen. "I moved here six years ago," he said as we walked up a narrow road toward his house. Chanting wafted from the spiritualist church nearby. Ilson was born on a farm, but when his father lost his job there, the family came to São Paulo, and Ilson found his way to the then active landfill. "I even had to eat things from the dump when I was starving," he said. "There was no other way for me. Rats were passing through my house all the time; it was terrible." He talked fast, almost compulsively, as people sometimes do who live alone. "But now that the dump has been closed, the amount of rats has decreased, and also the flies and cockroaches." Gone too is the stinging smoke from burning trash that once choked the air night and day. Many people who used to survive by scavenging recyclable material from the dump have found jobs at Volkswagen or in furniture factories, but they still live here. There's nowhere else, and besides, like Ilson, they've spent money and labor in contriving to build some kind of dwelling for themselves.

His house was spotless, three small rooms with a concrete floor, wooden walls, a tin roof, and a gas stove on which he immediately began to boil bottled water for coffee. He also had a refrigerator, a TV, and a small sound system, as well as an ironing board and two irons. One corner of the entryway had been arranged as a shrine, a typical Brazilian mix of Catholic and African religious motifs, ingeniously contrived with items he had found in the dump. "People think that because we're poor, we don't know how to do anything," he said.

He was eager to show me his garden. It was a kind of luxurious small wilderness of flowers and herbs, with white and yellow chrysanthemums, red dahlias, and pink roses, as well as rosemary, artemisia, and other healing plants. This profusion purified the air and refreshed his spirit.

We clambered up onto the bleak, gray-brown summit of the dump itself. Anything of value had long since been taken away; what was left was an expanse of sandy dirt strewn with plastic shreds and chunks of shattered concrete. But what Ilson saw were the wild plants. He wandered casually, pointing them out, almost introducing them. "This is good for your stomach and to calm your nerves," he said, showing me a few leaves. "That one makes a good salad." Holes and fissures released intense heat from the compressed decomposition under the surface, staining the air with an acrid smell, and the cluttered village below straggled toward a polluted reservoir. He paused and looked around, his eyes shining.

"You have no idea," he said, "how beautiful it is up here when the moon is full."

Bangkok, Thailand

Asia's City of Angels

The Thai people don't call their capital city Bangkok. The official name begins with the words Krung Thep and unrolls in a litany that means, in part, "the Great City, the Residence of the Emerald Buddha, the Grand Capital of the World Endowed With Nine Precious Gems, the Happy City" and so on. Krung Thep means City of Angels, and I believe it may well be.

The city's Asian contours are almost completely hidden now by a welter of skyscrapers, though along the banks of the Chao Phraya River you can still discern traces of its earlier tropical character: low wooden sheds, two-story houses with large breezy windows, temples and pagodas, and stretches of emerald trees, all still conjuring the spirit of Conrad. But the daily reality for its ten million people (unofficially) is to move sluggishly through a thickening, spreading metropolis wrapped in a gray film where air should be. I did everything I could to avoid the traffic. I took the Skytrain, riverboats, canalboats. I walked. I saw black clouds billow behind the city's antiquated buses. Pulmonary diseases, though not as famous as the city's AIDS epidemic, are widespread, and the noise pollution from bellowing traffic and thundering construction ratchets up everything from emotional stress to learning disabilities. By nightfall the atmosphere is so heavy and worn out that not even a small breeze can find the strength to move.

Bangkok is the only significant city in Thailand, and the third largest in Southeast Asia, so it's inevitable that it would lure new people. This has been going on for decades, as economic problems and family vicissitudes in the countryside and even in smaller cities make "the Big Mango" seem like the best place to make a fresh start.

Sakon Wisetwongsa ran away from home 40

BATTLING GRIDLOCK **Bangkok's elevated Skytrain flies through a downtown often paralyzed by traffic. On rush-hour streets, cars crawl and pedestrians choke on fumes. A subway system that will extend rail service should provide some relief by next year. Meanwhile, traffic delays cost Bangkok a million dollars a day in lost productivity.**

With just 12 percent of the population, Bangkok produces 40

years ago because he hated school. He grew up in Yasothon Province, 330 miles northeast of Bangkok. After working as a gas station attendant and then at other jobs, he started driving a *tuk-tuk*, one of the swarms of cheap, handy little vehicles for hire that are basically motorcycles that want to be rickshas. Now 56, Sakon, a heavyset man with a round face, an underslung jaw, and small, very round ears, was waiting for work at the stand outside the Grand Palace. I climbed aboard, and we roared off.

"I don't notice the noise!" Sakon shouted over the traffic. "I love to talk to passengers!" Thirty-three years at exhaust-pipe level hasn't dimmed his enthusiasm or his strength, astonishing when you consider that until recently he drove from 6 a.m. to 9 p.m. "Now I work from 6 to 8," he said, "because I'm getting old."

He pulled over near the flower market so we could talk a little more easily. "I worked as a cook for a while, then I became a monk," a not-uncommon Buddhist interlude. "Later my father got sick, and I went to my hometown. I stayed with him until he died, and when I came back, I saw the tuk-tuk drivers, and I thought, 'It looks like fun. I'll try it.' And it is fun. I love it! At first, when I was younger, it was really exciting—you can go anywhere. Now it's a little less exciting, and it's more difficult because of the traffic, and there are strict regulations."

Sakon and his wife, Suay, raised their three sons and a daughter on the two-baht fares he used to earn (now up to 30 baht, or 60 cents). But 20 years ago Suay's father became blind, and she went home to the farm to take care of him. Sakon stayed on in the city, living with his third son. He goes back to help her when he can.

"Actually, I really like being a tuk-tuk driver," he repeated. "I don't drink, I don't smoke"—with all the traffic, he wouldn't need to—and he makes a good living, some 17,000 baht ($420) a month. "But my son tried it for a year, and he complained about the traffic, the noise, the pollution."

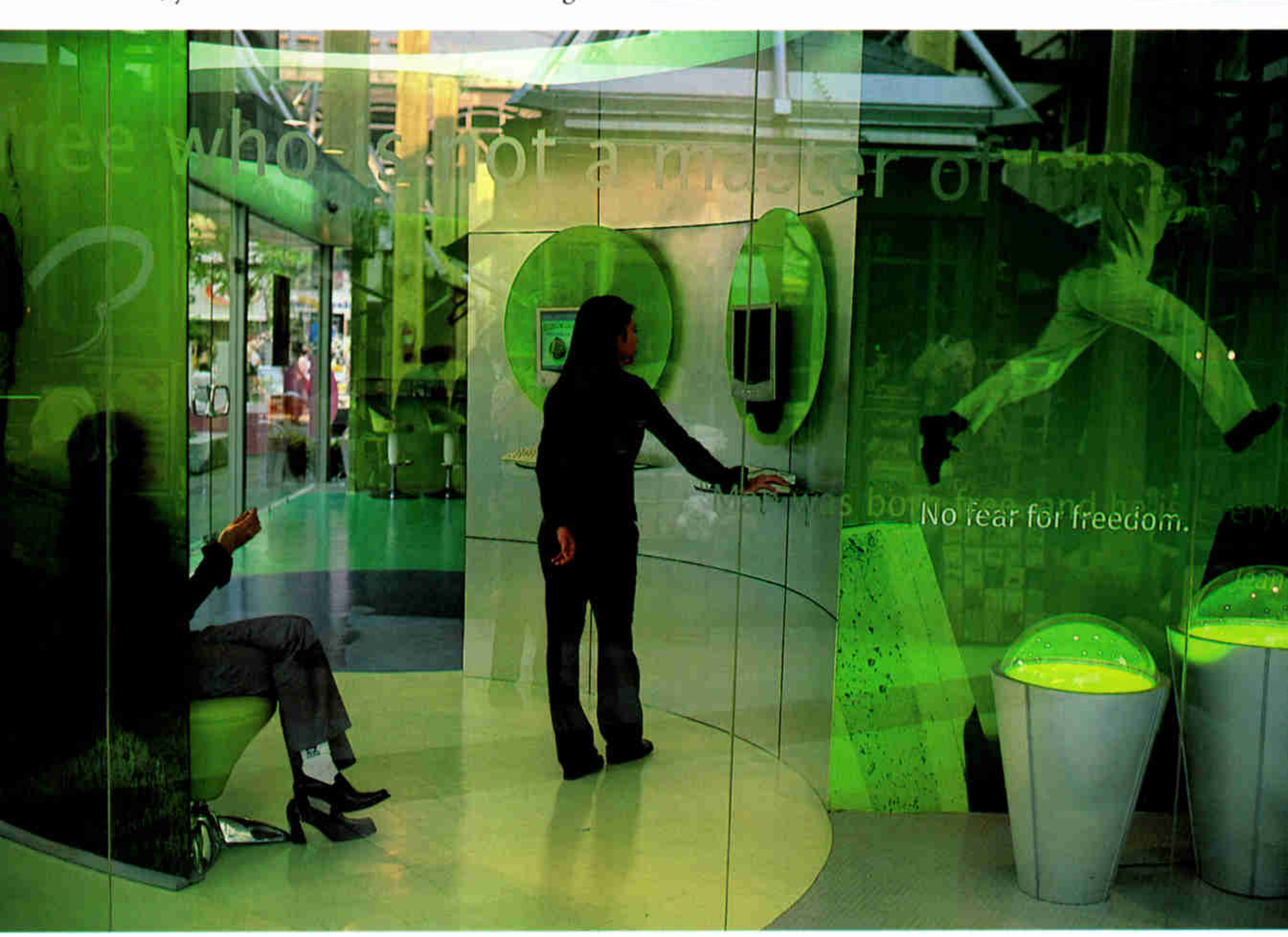
BOOMTOWN When a resident of Bangkok's Khlong Toei slum needs more room, he simply builds it himself. The already overcrowded neighborhood continues to swell as one of the cheapest central places to live in the city that dominates Thailand's economy. "The best jobs are in Bangkok," says Nuch Benjarpornbanyat (upper right), who took a position at Bangkok Bank after graduating from a top university. Cell phones, advertised at a cyber kiosk downtown (right), help make business possible by linking people—even when they're stuck in traffic.

percent of Thailand's economic output.

Sakon came to Bangkok decades ago; by now he's practically a native. But when I met Mod, she had been in the City of Angels just five days. Perhaps few would regard Mod as an angel, technically speaking; she works at a joint called the Prime Bar, one of the scores of more or less identical watering holes in the Sukhumvit area. Her job is to spend ten hours every day of the week, from 3 p.m. to 1 a.m., inviting passing foreign men to stop and have a drink, or better yet, several. Whatever may or may not happen between them after that is up to them. She gets two days off a month, and a percentage of the price of each drink the customer buys.

It was the war in Vietnam that created the bar-girl phenomenon, as soldiers flooded Bangkok and other Southeast Asian cities on R and R. Now package deals lure masses of middle-class tourists from Europe and Asia, and though most of them head for the beach resorts, you still see shoals of men in Bangkok moving through the nocturnal depths of Sukhumvit and Patpong. The girls are waiting for them, ready to haul in their drift nets. In the warm evening dusk the neon lights over the bar give their skin a chartreuse sheen. They are all watching the street.

Mod comes from Khon Kaen, a city in



northeastern Thailand, and you wouldn't have picked her out as a bar girl. Like most Thais, she has an easy, friendly self-confidence and a tranquil expression that is quietly appealing, but she's 34 years old now, with an uneven complexion and an ample figure that her tight jeans are unwilling to forgive. Though she may be starting a little late, she's here because she was ready to make a change in her life.

"I was a nurse's aide in the hospital," she told me. "Ten years ago I got my certificate from vocational school with a major in the hotel business, and I was offered a job in a hotel in another province." But new employees are required to either put up money as a kind of guarantee or provide a reference, which serves the same purpose. Mod didn't have either, so she couldn't take the job. She went to work in the hospital instead, but most of her 4,000 baht ($99) a month salary went to help her parents, and in ten years she never got a raise. When her work schedule increased to 12-hour shifts for the same pay, she'd had enough. Unmarried, with no boyfriend and no children, she wanted to know "what else there is in life." So she decided to come to Bangkok.

"I know this job isn't really socially acceptable," she said, "but I need to make money for my life and my family. I looked at the classifieds, but many jobs for my education level have an age limit of 20 or 25—anyway, not older than 30. My parents don't know what I'm doing here. They just know that I've got a job, that I'm looking for a better life in Bangkok. Still, I like the work. When you're a nurse's aide, you're with sick people, and it's kind of depressing. This is the opposite."

We were sitting on tall stools at the bar, dipping slices of unripe mango into a strange paste of pounded red chili peppers, sugar, and salt. Some of the other girls were listening, though of course they already knew the story. It was their story, more or less.

Mod may have had some second thoughts before making the move, but her friends had no doubts at all. When she told them she was going to Bangkok, "they all said, 'Go for it!' "—she threw her arms in the air, eyes alight. "They gave me a party; then they all came to the bus station to see me off. They said, 'You're the pioneer, and we'll follow you!' "

Lagos, Nigeria

Everybody in Lagos told me that things were getting better—or would be very soon now, just a few years after Nigeria's most recent military dictatorship had ended and democracy was taking hold. I heard from government ministers and ordinary people alike that what was needed in order to make a success of the crucial next few years was speed and patience—a recipe that could make sense only in Lagos.

Unofficially topping ten million people, it is the largest city in sub-Saharan Africa. Yet it has a strange atmosphere that photographer Stuart Franklin described as part frenzy, part lassitude. The streets and markets are swarming with activity, yet actually to accomplish something, from setting up an appointment to making a cash withdrawal against my credit card, would turn out to fall somewhere between immensely difficult and completely impossible. I began each day full of hopes and plans, and finished it feeling exhausted and inexplicably defeated—emotions probably shared by evening with countless others.

There is a strangling sort of feeling to Lagos, a city gripped both by geography and by history. It was a fishing village that the British annexed in 1861, "and so it grew without a strong indigenous government tradition," David Satterthwaite explained. "São Paulo is a city that developed a global role without being a national capital, but Lagos only grew when it was made the capital city." It lost that role in 1991, when the national government moved inland to Abuja, though Lagos remains the commercial center of the nation.

Geographically, Lagos is squeezed onto four islands in a broad lagoon, but with only three bridges connecting the islands to the mainland, the burgeoning city's traffic is intolerably compressed. Vehicles of every sort inch along dusty streets lined with a dense array of small shops, banks, eye clinics, mosques, and apostolic Christian churches with musical names like the Divine Chapel of Cherubim and Seraphim. Hundreds of people are making the same time, or better, by walking along the narrow, devastated sidewalks, often carrying something heavy —say, a sewing machine—balanced on their heads. Historically, Lagos is stuck somewhere

West Africa's Sprawling Giant

Lush with tomatoes, the Oshodi Market spills over railroad tracks in Lagos. With jobs scarce, most residents survive by selling whatever they can, wherever they can. Cheap and ubiquitous, market foods feed the city.

between its experience as a British colony and the series of military dictatorships that followed, the latest of which ended only in 1999.

So people feel an urgent need to get as much done as they can now, both to make up for lost time and to get ahead in case another coup slams the door shut on progress. This accounts for the sense of frenzy. "Our recovery is predicated on how well we can insulate the military from the economy," said Rauf Aregbesola, the commissioner of works. "We must turn the situation around in two decades. We *must*. Otherwise we'll just be at the bottom of civilization."

What made it so hard for me—and many others—to get anything done is the maze and minefield of politics, bureaucracy, and corruption, deeply rooted in a culture based on clan heads and tribal rivalries that have now taken on political significance. Many educated Nigerians, even officials, are profoundly frustrated.

"It's the failure of *everything*—of policy, of growth built on our interests," Aregbesola said. "There must be 10,000 graduates unemployed and underemployed in Nigeria—we're talking about a huge class of educated people. We had 5,000 positions and more than two million applications. The resources of the government are quite inadequate to meet the needs. The total annual income of Lagos State is 220 million dollars. What can you do with that? If Miami-Dade County needs 45 million dollars just to build new roads, what can we do here?"

So lassitude is the almost inevitable reaction.

TO LIVE IS TO STRUGGLE **Like New Yorkers, Lagosians take pride in being part of a famously challenging city: If they can make it there, they'll make it anywhere. Rich in urban ingenuity, Ping-Pong players in a poor neighborhood get by with scrap-wood paddles and a makeshift net. Pushing past a jam, motorcyclists squeeze through Alaba International Market, their bodies inches from idling traffic. In a more joyful squeeze (upper left) Lagos-born Agbani Darego was welcomed home last year as the first black Miss World from Africa.**

Despite Nigeria's potential wealth, with its rich reserves of oil and timber, two-thirds of Lagos's people live below the poverty line. The gray liquid of the stagnant channels of water lining most streets shimmers with mosquito larvae, harbingers of malaria. Tax collection is erratic and inadequate, one of many reasons why the government coffers are slim. And bribes are regarded by everyone as unavoidable, even necessary. One civil servant spoke openly about his struggle to provide for five children at home, two of whom are his dead brother's sons. "When I took this job, I was determined not to accept gifts," he confessed with evident anguish. "But now I see there's no other way."

"Lagos has a lousy reputation," said David Satterthwaite. "Now it's struggling to cope with the fact that its capacity to attract global investment isn't very high." Actually, "Struggling to Cope" would look very well inscribed as the motto on the city's coat of arms. "You really have to work hard, to struggle," said Natania, the soft-spoken young man I often hired to drive my rented car. "Things don't work out the way you want, but what can you do? You have to cope the best you can."

Almost everyone is improvising. "It's typical of people here to survive without jobs," an imam told me outside his mosque. The common term is "informal economy," though "black market" and "off the books" define the same thing, and it is what is keeping Lagos alive. Everyone manages somehow to scrape up even a tiny amount of money; Stuart's assistant even paid a woman to wash our fruit for us, though we could easily have done it ourselves. Not only are the markets a chaos of commerce, the streets are lined with vendors offering delicately peeled oranges or golden brown smoked fish, and at every intersection hordes of young men and boys

Most residents of Third World cities lack sanitary sewage

A dead dog floats with waste in Ebute Metta Lagoon, a thoroughfare for fishermen who build houses above its waters. Floods can carry these fouled waters into Lagos city streets, posing a public health hazard.

disposal; about half have no adequate supply of drinking water.

GETTING THINGS MOVING **Workers in Lagos pour a sidewalk for a four-lane highway that will replace a two-lane road. As with other urban areas in developing countries, Lagos was transformed from a walking city to a car city without time for the creation of mass transit. A 156-mile government road-improvement project aims to help clear the city's clogged arteries.**

weave among vehicles offering passengers every conceivable object: magazines, used shoes, mousetraps, envelopes of starch, bags of fruit juice, recharger cords for mobile phones, sunglasses, CDs, even toilet seats. If the traffic starts moving in the middle of the negotiation, they trot alongside the car, still talking. By the time they finish the sale, they can be running.

I stopped one day toward noon at an intersection; a young man in a black T-shirt that announced "I'm a Quiz Genius" was standing between the median strip and a lane of cars, holding out a fistful of dog leashes. His name was John Cheku, he said, and he came from Edo State, about 200 miles east of Lagos.

"I've been doing this for seven years," he said, keeping an eye out for some sign from a driver. I couldn't remember ever having seen a dog in Lagos. "I might sell six leashes a day for 150 naira [$1.25] each. I don't make much profit." Not enough to send money home, in any case. The sun was beginning to hurt; he turned his green visor around to shade his eyes. Two lanes of cars rolled past; the fumes and heat were painful. No dog owners so far.

"I always work this intersection," he said. "I came to—how do I put it—we don't have much money in our situation." It was awkward, but better than saying "I came because I'm broke." "I came by myself. I don't want to involve myself in any bad gang, that's why I'm doing this. I would like to be a musician on a stage, to entertain people." I stayed with him half an hour; he didn't sell a single leash. "No, I don't get discouraged," John Cheku said, "because I know that God is life."

If the spectacular energy and tenacity that Lagos's millions expend on sheer survival were to find some means of producing tangible results, the city could have real hope of becoming, as Aregbesola boasted, "the capital city of the black race."

As it is, it's every man for himself, hoping for the best, praying like crazy.

Hyderabad, India

The Next Silicon Valley?

Hyderabad these days is on the sunny side of the street. Till 1948 it was the capital of India's richest princely state, a feudal city of gardens famed for pearls and palaces and governed with tolerance and culture by a dynasty of Muslim rulers called nizams. Today it is poised to become the high-tech capital of the subcontinent. A mere seven years after N. Chandrababu Naidu became chief minister of Andhra Pradesh State, its biggest city (which half a century ago was planned for a maximum of 500,000 inhabitants) has surpassed five million. House and land values have soared, roads are being widened, parks built, and a whole new suburb has sprung up to house the offices of Microsoft, Infosys, Oracle, and the International Institute of Information Technology, as well as facilities for pharmaceutical and biotech research, and even banking and insurance companies. Part of this development is called Hitec City, but it is only part of a larger suburb known as Cyberabad.

It all started with taxes and trees. "Andhra Pradesh isn't richer than other states," one man said. "It's better governed." What Hyderabad did was completely restructure and streamline the city's property tax system. "There's a syndrome called rich city–poor city," explained P. K. Mohanty, a secretary to Naidu and former commissioner of the city's governing body. "The property values are high, but the cities themselves are poor because part of the wealth hasn't been tapped or hasn't been translated into the welfare of the people.

"First, there should be a visual process—you should show that something is happening," he said. "So we got the city clean. We gave 65 percent of the city services to private contracts, and now we've won the Indian Clean City Award for the fourth year in a row." Then there was a massive "greening" of the city. A substantial donation from the Netherlands that paid for millions of saplings inspired HUDA, a government agency, to begin transforming some of the city's uglier areas into parks and gardens. Flowers bloom beneath expressway overpasses and border the streets. Environmental problems are chronic in the developing world; in São Paulo, rampant paving over of the hilly periphery to make space for houses now causes devastating late summer floods that block streets and float away city buses and Mercedes-Benzes alike. In Hyderabad, conversely, trees are everywhere.

Then the city started collecting taxes. "Large cities in India are very corrupt, including Hyderabad, because money is abounding," Mohanty said. "Thirty years back there was a lot of evasion due to collusion between the tax officials and the public. Technology is the best solution for corruption. If you simplify, if you eliminate people-based transactions, a lot of corruption will be eliminated. So we computerized the tax records. And now people are cooperating. They find that lights are running, that roads are swept, and we got 124 percent growth in property tax. So today we've got a certain capacity to spend." Not only this, but government staffing has been trimmed; municipal salaries account for about 20 percent

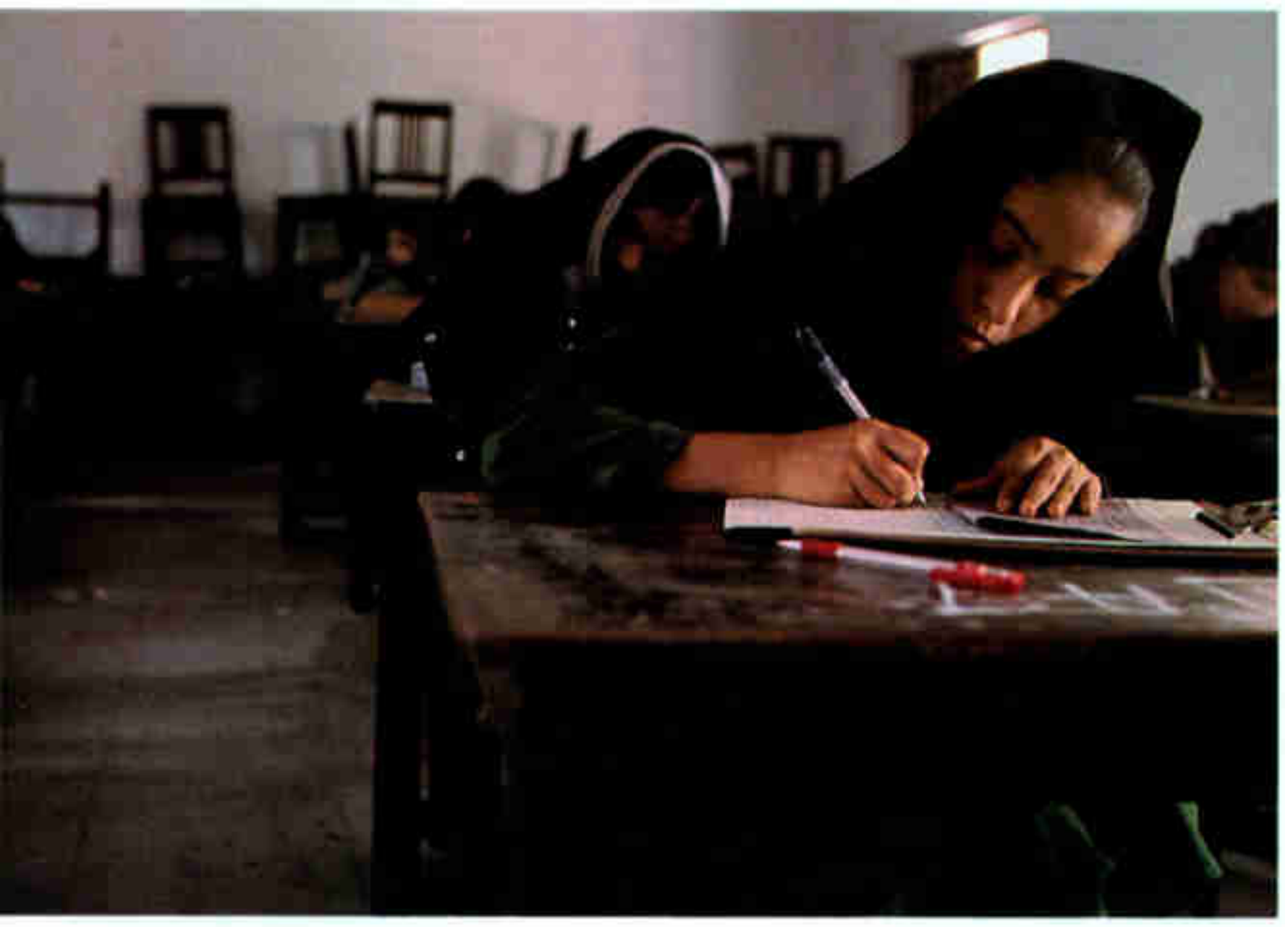
UNQUENCHABLE **Clearing weeds from a lake near Hyderabad helps keep it and the groundwater clean. The city's growth has outpaced its water supply; some areas can turn on the tap just once every other day.**

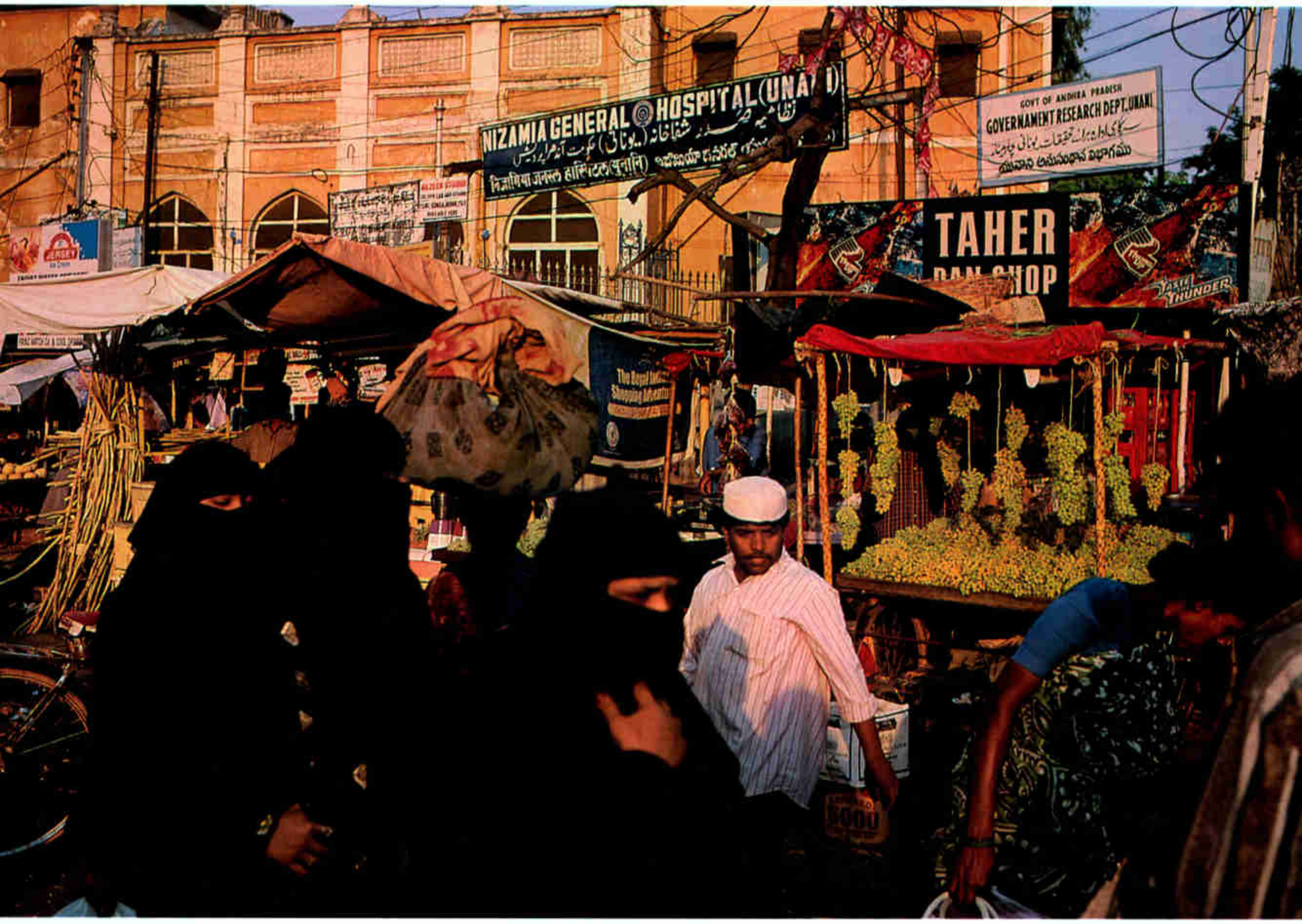
of the city's total budget, remarkable in bureaucracy-bloated India.

"What we need in India is not money," Mohanty said forcefully. "We need reforms. Large cities of the Third World are reservoirs of wealth. The problem is one of poor management. If cities are properly managed, there cannot be resource problems. If you tax the people who benefit from the cities, there's no way a city can be poor."

Bracing, evangelical talk. Of course, as one man put it, "We need working hands, not speaking mouths." And I saw the hands at work everywhere, from a garbage dump converted to a park, to women sweeping the streets at midnight, to the eSeva centers, the new computerized offices where you can pay your bills, apply for a passport or driver's license, or get a copy of your birth certificate. There are now 18 in the Hyderabad area (50 total are planned). I went with Ajay Sawhney, special secretary of the Department of Information Technology and Communications, to see one at work.

In India a person normally can spend hours going from office to office, standing in long lines, in order to pay each utility or other bill, and payment offices are open only from 10 to 2. At the eSeva center you can make one stop to pay them all. (The visit would be worth the





small handling fee if only for the blast of air-conditioning.) Quick, simple, cheap: Old stuff in the First World, revolutionary here. And the office atmosphere—in India often a thick blend of anxiety and futility—was serene, efficient. The office was full. In the first two hours of business, tellers at all the centers had handled 1.4 million rupees ($30,000) of transactions. And they were going to be open another eight hours.

Not only is it remarkable that all this has happened, but that it has happened so fast. Chief Minister Naidu is universally given the credit for this dazzling leap into the future by having clear ideas, putting the right people in charge, and giving them all cell phones and insisting that they always be turned on. He can call at any hour, and often does, a sort of cyber-nizam for the third millennium.

But the speed of change has not overwhelmed the memories that many still have of the earlier Hyderabad, the graceful town of culture and wealth. In Hyderabad you can still hear people talk about their city with an appreciation that is rare in the developing world.

"I do love Hyderabad, otherwise I would have sold out and moved anyplace," said Lakshmi Devi Raj. Lakshmi's father was the nizam's personal physician, and she grew up in a Hyderabad in which all the old families knew each other and "time was of no consequence." Still elegant at 70 with softly swept-up hair, a delicate black line edging her eyes, and a gentle voice, she now designs saris of exquisite fabrics whose patterns are traced with all-natural dyes. "As a child, I was very fond of dancing," she said, "but when I told my mother, she slapped me and said, 'Don't even think of it; girls from decent families don't dance and sing. Don't ever speak to me about it again.'"

Lakshmi took me to visit her family's jeweler, the 125-year-old firm of Vithaldas and Company in the Old City. Vijay, the founder's grandson, pulled out trays of antique pieces, chokers of

URBAN MAKEOVER **A dynamic government is racing to transform Hyderabad into a high-tech hub—without sacrificing breathing space. In the city center the government turned a former electrical plant site into the sleek NTR Garden (below). Around the city's edges new buildings are filling with software businesses. About 90 percent of its children, including these students from poor families (upper left), attend school. Yet despite a literacy rate almost as high, tens of thousands of residents still work as low-paid sellers in street bazaars (left).**

gold filigree with emerald drops, necklaces with clusters of the luminous old Basra pearls the nizam was so fond of. He pointed out the differences between the Hindu and Muslim designs.

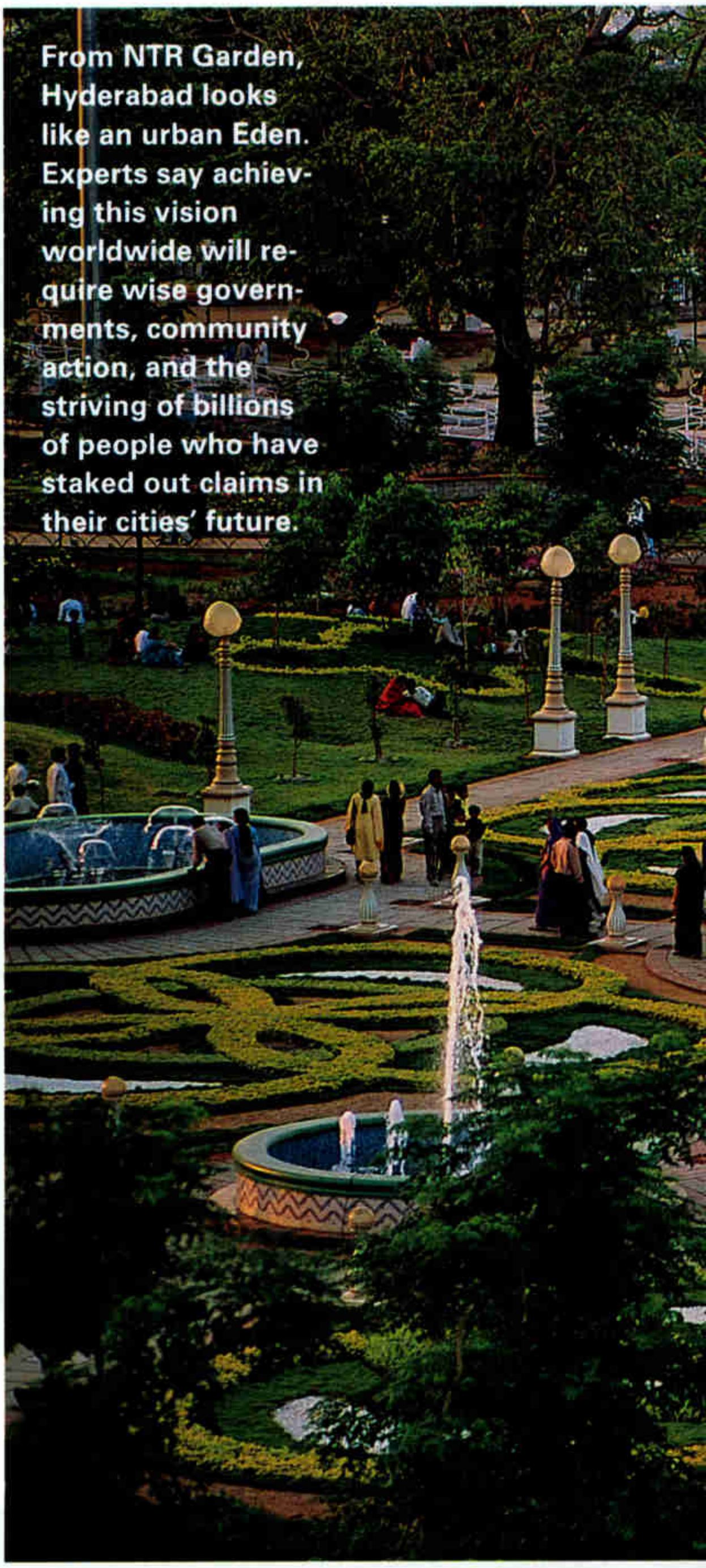
"We never wore just one piece," Lakshmi was saying. "We wore it all when we went to weddings." She started putting on bracelets and necklaces to show the effect. "And as many rings as possible. At least six rings, but not on the thumbs. We used to get tired in the summer and take the jewelry off and pass it to our mothers. It was so heavy. My mother would say, 'Why are you making such a fuss? Don't you see how I'm dressed?' My mother would be wearing a kilo of gold, between her belt, her bangles, and her earrings." In the salesroom next door, every seat was taken by mothers and their daughters, intently examining trays of 22-karat gold jewelry for imminent weddings.

The shop was a glimpse not only of monetary wealth but also of a richness of culture and history, precisely the elements that cities have always prided themselves on. I had felt the same pleasure in São Paulo with José Mindlin, one of the world's greatest collectors of rare books, as he showed me some of the treasures in his private library: a first illustrated edition of Petrarch, a delicately illuminated medieval Book of Hours, and what is probably the finest collection of books on Brazilian history anywhere. He had spoken of his city the same way he spoke of his books, with passion and understanding. Cities, I was reminded always by surprise, aren't mere agglomerations of issues, but living organisms still capable of beauty and delight.

When Lakshmi was young, she could savor life in a city that was leisurely and serene. Young people today love Hyderabad too, though with perhaps less poetry. "The city gives you very good vibes," said Gargi Wattal, a young Kashmiri woman from New Delhi who came here in 1998 and now manages operations for an insurance company. "At first I felt lonely, then I realized the city was growing on me. People here are very hardworking, a very gentle attitude, very simple and sweet."

"Living in Hyderabad kind of spoils you for living in other cities," said Chitra Sood, the manager of finance and administration at Microsoft. "I love the way Hindi is spoken here. A purist would shudder at it, but it's so distinctly Hyderabadi. It's a funny mixture of Hindi, Urdu, and Telugu, with all the wrong grammar: the tenses are all mixed, the genders are all mixed. I love it. It represents India, actually."

Hyderabad's dreams would sound extravagant—a new international airport to rival those of Mumbai and Delhi, for instance—if the city hadn't done so much already. "It's not



From NTR Garden, Hyderabad looks like an urban Eden. Experts say achieving this vision worldwide will require wise governments, community action, and the striving of billions of people who have staked out claims in their cities' future.

MORE ON OUR WEBSITE

Photographer Stuart Franklin shares his thoughts on traversing and photographing these burgeoning cities in an interview at **nationalgeographic.com/ngm/0211.**

that everything we're doing is correct," said Mohanty. "But even without doing everything, you can improve." "Improve" isn't one of those clarion words that jolts you to action, but it is the secret to success. Vast schemes, grandiose theories can never achieve the same benefits as the accumulation of smaller, consistent, attainable goals. Hyderabad is one example of what the sum looks like when the many smaller parts that actually work are added up.

Three months earlier I had flown over São Paulo in a helicopter. Luli, the artist, was with me. I was overcome by the sheer scale of it all, but Luli was enchanted. "I thought of all those people down there," she told me simply later, "trying to be happy."

In São Paulo a new street is added every day. One of them is called Travessa Bate Coração —Heartbeat Street. That could be every street in every city in the world. □

Kings of the

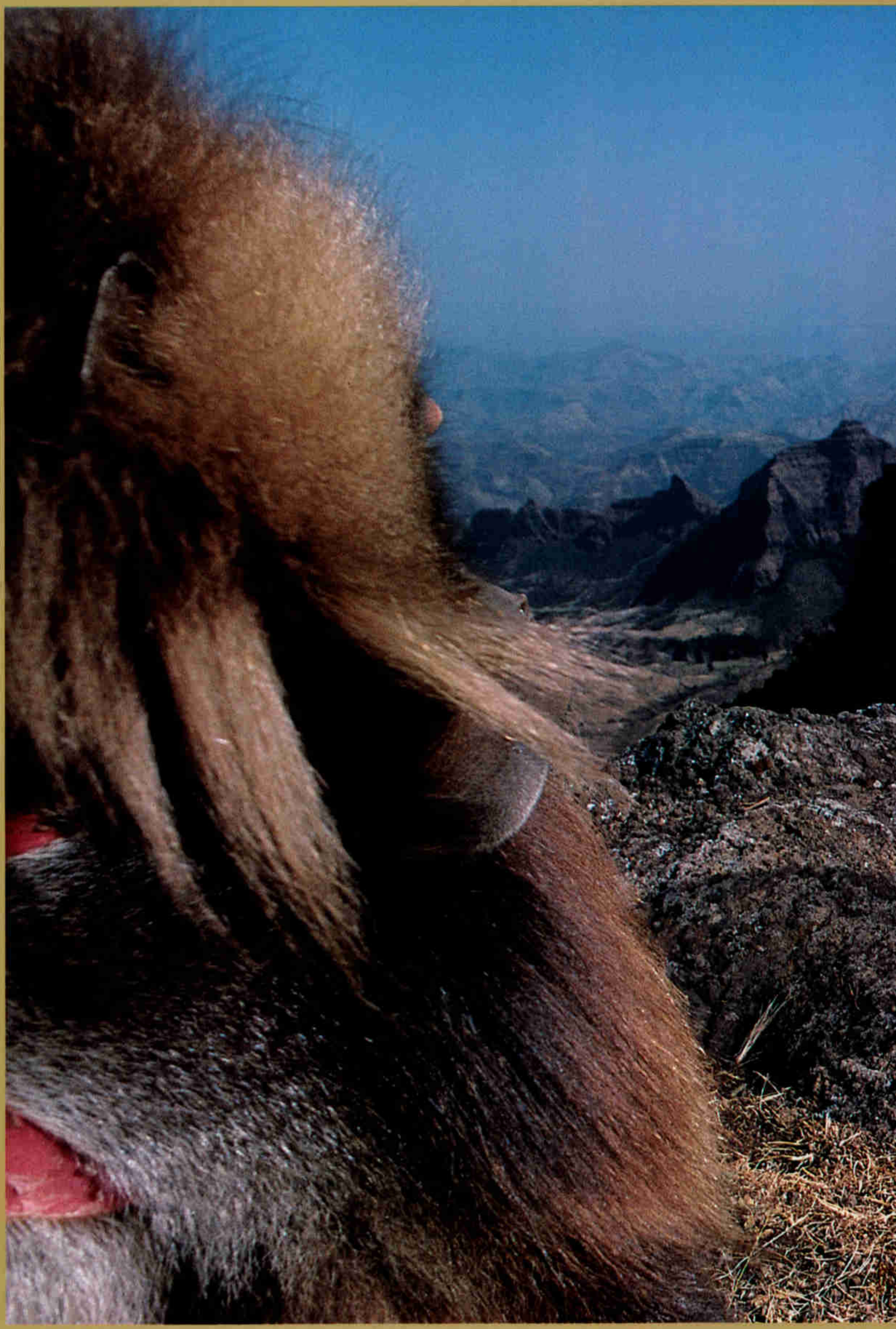
Well, yes and no.
With fangs bared and gums blazing,
a male gelada looks tough enough. But
in the Ethiopian highlands make
no mistake: The queens are in charge.

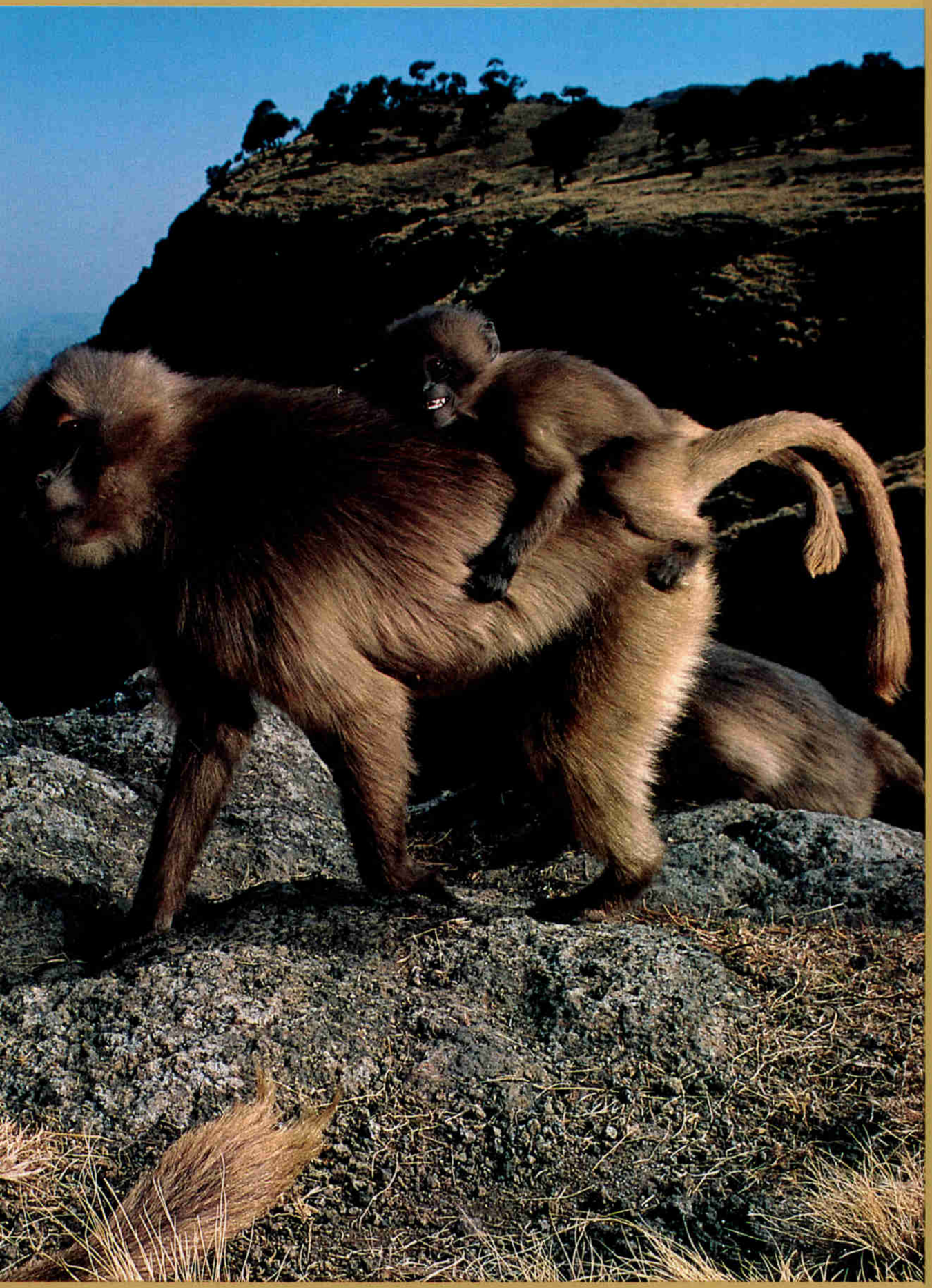
By VIRGINIA MORELL
Photographs by MICHAEL NICHOLS
NATIONAL GEOGRAPHIC PHOTOGRAPHER

Hill?

Don't mess with big daddy—or big daddy's hard-won females. Retracting brows to flash pink eyelids, he tells a male rival where to go.

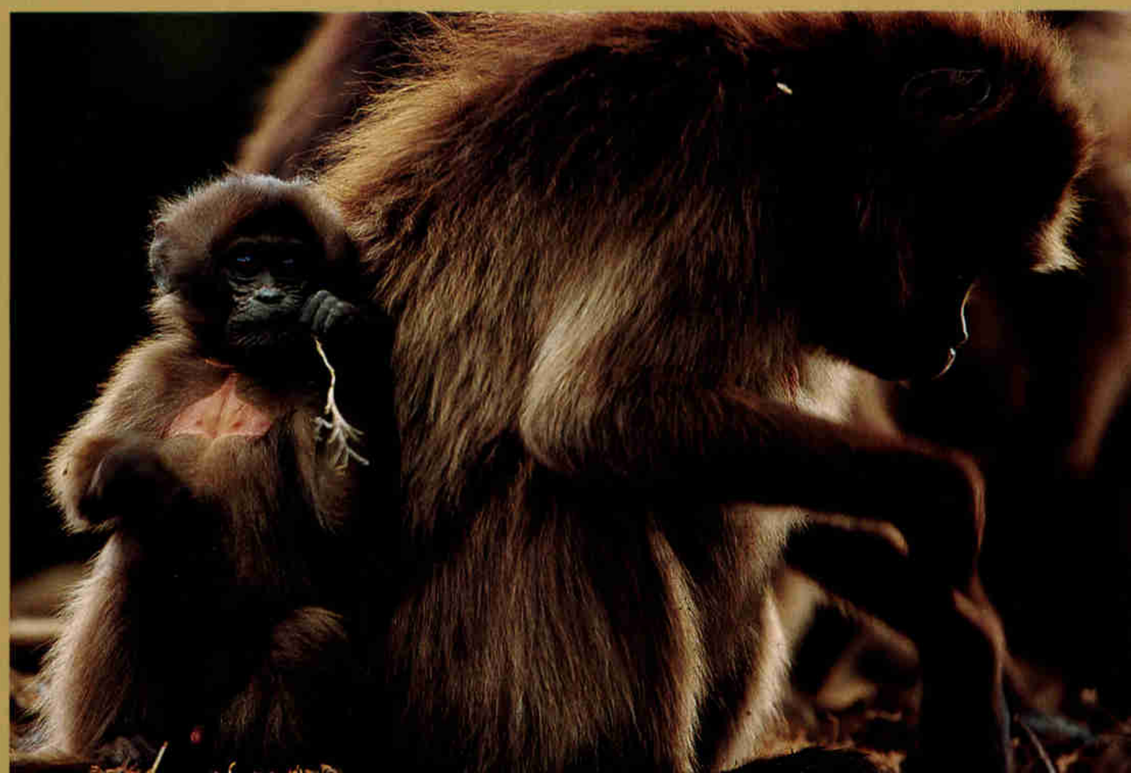
It's the way of all geladas: Family males—those with prized females at stake—must contend with lustful bachelor foes. The opponent at right "won't even meet the top guy's eyes," says biologist Chadden Hunter, "likely because the females are sticking by the incumbent, hovering in his shadow." Ah, but choosy females can easily cause a power shift. "Females will change males as quick as putting out the garbage," Hunter says. "So the new guy will be back to try again."





Be they ever so nimble, geladas clasp crags, pick fleas, and yank grasses with uncanny precision. It's a living.

Theropithecus gelada make it look easy. Consider their a.m. scramble up the Simen Mountains' sheer basalt towers, rooted in abyssal, flood-carved gorges. An expert climber and first to summit, a male (left, at left), head swiveled to keep tabs on his family, is greeted by a teasing lip-flip from his offspring—a gesture of aggression among adults. "Infants get away with a lot with dad," says biologist Hunter. "Males won't lift a finger against them for fear of mum's angry response." Mothers, in contrast, punish often and with flair, biting or flinging misbehaving infants but not injuring them. In peacetime, grooming cements family bonds (above, a female picks clean her mate's tail), and steady grazing fills the hours. Geladas' dexterous hands are grass-plucking machines, moving as many as 150 blades a minute from soil to mouth. In drier times the monkeys bend their wrists and pound the earth with rigid fingers (below) to get at the roots down under.



He barks and lunges in chase. She dodges and shrieks for backup. That's what can happen when female geladas flirt a little.

This was an unusually violent pursuit. "She strayed too close to a bachelor group," says Hunter. "But I was shocked to see such a ferocious display by her mate." Tables will turn on the chaser when other females—screeching spitfires gnashing their teeth and waving their nails—come to rescue one of their own. "He'll wish he'd never started it," says photographer Nichols. "The females will really go at him."

Monkey business abounds wherever geladas amass—and warrants nary a second look.

They swarm the plateau, sometimes 800 strong, in family units averaging four females per male, plus young. With females in synchronal estrus (announced by swellings on their scarlet chests), a family male (with a similar fertility badge) must mate with all in his group to keep from being replaced. "It's a constant battle over sex, space, or a juicy patch of grass," says Hunter. Male spats (left) are mostly brief cheek-puffing, teeth-grinding rituals, but a chorus of chiding females (right) makes a lasting impression—at least on Hunter. "That's three generations of anger aimed at one male," he says. "Glad it wasn't me."

If they could play cards and swig beer, they probably would.

Instead, a gang of gelada bachelors lounge under ancient heath trees, flashing eyelids at a family male (not visible) that provokes them daily with aggressive postures. Like related females, all-male groups will defend and groom each other and huddle for warmth—kind acts between future foes in the battle to reproduce.

Theropithecus gelada, the last of its genus, lives in a world as high as 14,000 feet and often barely the width of a monkey's bum.

Born of volcanic inferno some 30 million years ago, Ethiopia's highlands offer what the specially adapted gelada needs: grassy plateaus for grazing and sheer cliffs with narrow ledges that, though pounded by wind and even hail, are perfect night hideouts from jackals, hyenas, and leopards. The herd safely tucked in crevices below, a lone bachelor savors twilight with a view of the last place on Earth for his kind. As many as 200,000 geladas survive in this harsh landscape.

PETE WAS HAVING A ROTTEN DAY. His left hand was swollen and oozing pus, forcing him to limp on his three good limbs. He had trouble feeding himself, and he couldn't groom his four female consorts. And now a handsome young bachelor was flirting with them. Could it get any worse?

"It can, and if it does, Pete will lose his family," said Chadden Hunter, an Australian wildlife biologist who studies geladas—grass-eating, baboon-size primates found only in the mountains of Ethiopia. This was exactly the kind of gelada behavior he had hoped to show me when he invited me to his mountaintop study site: a male fighting to retain his position. Hunter has observed numerous such takeover battles among his study population and generally refrains from taking sides. There was only one problem: Hunter liked Pete. "I've watched him for four years, and I hate to see this happen."

A few moments later a line of young bachelor geladas charged among the grazing primates, yelping a challenge. Their honey-colored manes ruffled in the wind, their canines flashed in the light, and they snapped their long tufted tails up and over their backs. All eyes—gelada and human—followed their show.

"That's meant for Pete," Hunter whispered, "and his females." And Pete seemed to know it. As best he could, the injured gelada raced toward his mates, his left hand held up awkwardly, a look of what Hunter called "sheer terror" on his face.

"He's trying to round up his females. But they hate that. It'll only make things worse," Hunter said, groaning. "Oh, Pete. . . ."

Hunter the objective biologist jotted his dispassionate field notes. But Hunter the fellow primate shook his head in dismay. As for Pete's harem, they barked at him briefly, then resumed their grazing. *Snap, snap, snap.* With quick little moves they broke off the fresh grass blades and pushed them in their mouths. Punier and scruffier than their big-chested, fancy-maned male, the females nevertheless held the reins of power, and it would be entirely their decision whether Pete stayed or was toppled. For in gelada society there is one underlying law that governs all behaviors: Girls Rule.

Theropithecus gelada, as a gelada is properly called, is the last species in a once great dynasty of grass-grazing primates. Some three million years ago several species, one as large as a gorilla, ranged throughout Africa and into India, but all except Ethiopia's gelada vanished as the African continent warmed and its grasslands shrank. Only in the cool heights of the mountain meadows of north-central Ethiopia did a *Theropithecus*-friendly habitat survive. Today between 100,000 and 200,000 geladas remain in the country. Although they

are not endangered, geladas are considered threatened because of their fragmented habitat and because of Ethiopia's growing human population and expanding farmlands. Pastures and fields now encroach on prime gelada terrain—the 10,000-foot-high alpine meadows of the Simen Mountains, where Hunter and I had come several days prior to Pete's bad afternoon and where it's not uncommon to see geladas grazing alongside horses and cows or close to a farmer's barley field.

"The geladas truly are the last of their kind," Hunter told me. Built like a rugby player, the 29-year-old Hunter stomped uphill through a meadow dotted with pink and blue wildflowers.

"They're egging them on, like a bunch of kids at a schoolyard shouting 'Fight! Fight!'"

We were in Simen Mountains National Park, Hunter's base for studying the geladas since 1997. He knew every glade and cliff the primates favored. "They're so different from other primates in their diet and social behaviors," he said, stopping to look out over the sharply carved peaks and bluffs characteristic of the Simen scenery. "Even their habitat surprises people."

Geladas are creatures of the mountaintops, unlike most other African primates, which live in forests or low-lying savannas. During the day geladas wander through the high meadows and open forests along the Simens' steepest cliffs. At night they drop over the rocky precipices to narrow ledges—the kind of vertical terrain where falcons and vultures perch—and sleep huddled together against the freezing wind and cold.

Despite their distinctive status and ways, geladas are relatively unknown. Hunter's is the first long-term field study of the species in more than 25 years: Earlier research projects in the Simens, which reported many of the geladas' unusual behaviors, ended in the mid-1970s when Ethiopia fell into a dark cycle of famine, war, and rebellions.

"No one even knew how many geladas were left," Hunter said as he surveyed a nearby group of the primates. From a distance, with their golden brown tresses backlit by the afternoon sun, they looked like small haystacks, albeit moving ones, as they shuffled across the lawn picking handfuls of grass. Occasionally they glanced our way and barked or flicked their eyelids to remind us to keep our distance, but they'd grown used to Hunter's presence over the years and were not unduly alarmed. Hunter knew many of them by sight and had named certain individuals, like Pete. But he noted that even longtime observers had trouble telling geladas apart. Their dark facial skin, upturned noses, and deep-set eyes vary little from one to another, and he had resorted to using injuries or scars as markers and binoculars to get a closer view of their features.

"Among primatologists," Hunter continued, "geladas were always talked about as almost mythical animals. There was a mystique about them simply because they hadn't been seen for so long and because of their female-centric social organization." Like their closest relatives, the *Papio* baboons, geladas live in societies with such tight female bonds that the males often seem little more than party crashers at an invitation-only social event.

The gelada sisterhood is organized around family units of between two and eight related females, their offspring, and a primary male like Pete, which researchers call the family male. While other subordinate males are often attached to this basic unit, only the family male mates with the females. And none of these males—family male included—have any say in what the family does from day to day. Instead, like a Taliban leader's worst nightmare, the females decide everything: how long and where to graze, when to move, where to sleep. They also choose the family male and are not shy about demanding what they want from him, whether it is grooming, fighting on their behalf, or sex.

And that was why Pete was in trouble. A one-handed male would have great difficulty pleasing his consorts while keeping younger bachelor males at bay. The bachelors, "young toughs about five to eight years old," as Hunter characterized them, live in separate groups, although they spend most of their time close to the families, spying on them and looking for opportunities to oust the family males. Until a bachelor succeeds in replacing a male like Pete, he will never mate with any of the females. And if a family male loses his family, as Pete seemed

about to do, he also loses all mating rights. "The only males that get sex in this society are the family males," Hunter reiterated. "There aren't any secret matings. It all happens right out in the open."

HUNTER HAD SPOTTED Pete's position-threatening injury on our first afternoon among the geladas. Several months had passed since Hunter had last been with them, but by moving slowly and making some mumbling, gelada-like contentment sounds—*mmpf, mmpf, ummm*—he finessed our way right into the center of gelada activity. All around us the animals sat hunched slightly forward, plucking grass and herbs. Geladas are extremely vocal, with a repertoire of over 30 different sounds. The air was full of their calls, some muted and soft when they were grazing peacefully, others sharp and angry when one family strayed into another's feeding area. Every so often an anxious female called out *aaangh*—human!—if she grazed too close to us, or gave a quick *ang*—dog—if she spotted a farmer's cur. But mostly there was the sound of 800 hands snapping off the slender blades of grass, a sound not unlike the steady tap of a gentle rain against a windowpane.

Hunter, who had been surveying the geladas, looking for those he knew best, suddenly bore in on a male that sat only ten feet from us. "I think that's Pete," Hunter said. "I named him after a wonderful, wild-haired professor of mine, so I have a soft spot for him. But what's happened to his hand?"

Hunter lifted his binoculars to study the male's face. Pete had unusually deep and wide wrinkles on his face as well as a scar shaped like an X beside his nose, and one of his female partners, Monica, had a deformed upper left arm caused by parasitic worms. Hunter always looked for Monica after sighting Pete just to make sure he had the right family. "Well, Monica's there, and that one with the kinked tail is another one of his wives, Sandy. And he has Cathy and Jenny with him too."

Monica was Pete's grooming partner. In some primate societies that relationship might put her at the top of the totem pole, but not among geladas. "It simply means she doesn't have any close females in the group to groom with," Hunter said. "Maybe she's only had sons and no daughters, so she doesn't have any strong female allies and is stuck with Pete. Cathy, the alpha, would never lower herself to that." Indeed, Hunter explained, Cathy barely paid any attention to Pete, "except when keeping him in line and when she's ovulating."

Cathy might ignore Pete, but on this sunny morning she was grazing beside him; he had not yet lost her support. "He still has his family, but he's going to have a tough go of it," Hunter predicted. "It looks as if he's broken his hand."

Aside from his injured hand, Pete was

A Highland Park

Protected but still farmed and heavily grazed, Simen Mountains National Park (green border) houses only one percent of all geladas, including Chadden Hunter's study animals. The rest of these endemic monkeys (or crop-eating pests to locals) occupy just a fraction of *Theropithecus'* historic range, scattered about the highlands, with a small, isolated population south near Goba. Climate change, which helped wipe out related species, now threatens the alpine grasses that nourish *T. gelada.* Says Hunter, "A few degrees warmer and the geladas could run out of food."

everything a family male should be: A wedge of long, brushy whiskers sprouted from each cheek, his mane was a silky mass of gold, and on his chest he bore the ruling male's distinctive mark—a bright red patch of flesh that flashed in the light like a large medal. The chests of every gelada, young and old, male and female, had a similar curvaceous area of bare skin, although instead of being red, most were a pale shell pink. Hormones dictate the color of the patches, with females in estrus and family males bearing the reddest ones. Youngsters, nursing and cycling females, and bachelors have the paler pink shade. But a bachelor's pale patch turns warrior red within 24 hours of being invited by the females to take over a family, while the old male's recedes to pearly pink.

So distinctive are the colored patches that geladas have been dubbed "bleeding heart" monkeys, and local Ethiopians like to tell a fanciful tale about God branding the first gelada on its chest for misbehaving. In fact, the patches are more like billboards than signs of grace or sin, and they signal the latest news about each gelada's sexual state.

"In most other primates that kind of information is shown with swellings around the buttocks," said Hunter. "But because the geladas sit down most of the day to feed, they can't use their bottoms for their sexual displays. They've evolved these rosy chest patches instead."

Even to our human eyes the patches proved very effective signposts. Although the geladas were spread out around us over an area of about two football fields, we had no difficulty picking out the females in estrus, the prime family males, and older deposed males—a quick glance at their chests told us all.

"It really is amazing how the ousted family males lose their red chest color; it just vanishes overnight, as do their mating rights," said Hunter. But despite their drop in color and sexual status, the toppled males don't leave their families. Rather, they stay on in a kind of grandfather role, Hunter explained. "That way they can protect their children, and they're very aggressive about that." Hunter had seen old males face jackals stalking their families. "The new young guy won't do that. He has to think about producing his own offspring." At the same time a new head of the family does not harm the babies of the preceding male—unlike some species, such as lions and gorillas, in which a new male may kill the youngsters in order to bring the females into estrus. In geladas nothing angers the females more than males barking at or striking one of their children. "That is the surest way to get ousted," Hunter said. "It's the gelada equivalent of driving a car into a school bus."

More typically, males fall from grace for a host of smaller errors, primarily not giving their females enough attention. Sex in particular is a key female demand (females have a baby about every two years), and Hunter wondered if Pete was up to this task. "He can't use that hand to groom or feed, so he has to be weak," Hunter said, noting that geladas consume 100 to 150 grass blades a minute when grazing with both hands. "He's only getting half that amount, and it's a pretty poor diet in calories anyway."

Another male suddenly appeared, swaggering like a street tough past Pete's family.

We weren't the only ones assessing Pete's chances. Keen sighted and socially cunning, every gelada bachelor in the vicinity would soon spot an injury like Pete's and begin plotting. "Sooner or later someone's going to test him," Hunter said. And as if on cue, another male suddenly appeared, swaggering like a street tough past Pete's family. The bachelor had fluffed up his mane into a Rod Stewart–like coiffure, flicked his pink eyelids, and curled back his black upper lip to show off his long canines and pink gums. The younger male's pose did the trick, and instantly Pete raced toward him, barking and screaming, with every hair of his own mane lifted aloft. The two males tore across the meadow, then vanished into the forest of giant heath trees. All the other geladas stopped feeding to watch and add their own cries and shouts to the dispute, and a passel of adolescent males ran to the front, screaming like cheerleaders. "It's almost like they're egging them on, like a

bunch of kids at a schoolyard shouting 'Fight! Fight!'" Hunter said.

A moment later Pete reappeared. He loped across the meadow, tossing his mane triumphantly, and ran back into the center of his family to sit beside Monica. Pete had successfully chased off the intruder and now wanted "some approval for what he did," Hunter said. "He might expect to be groomed for having shown up that young hotshot." But Monica turned her back on Pete, and none of his other consorts offered any grooming praise either.

"Well," said Hunter, exhaling softly. "This isn't anything new, I don't think. Whoever that young bachelor is, he's been here before, and he smells blood. He's got something on the boil."

Minutes later the bachelor was back, once again testing Pete's strength and the allegiance of his family. And again Pete chased him away. But for the next hour the bachelor returned every few minutes to prance and parade, tempting the females and taunting Pete. The two males bared their canines, growled and barked at each other, and raced into the forest several times, yelping and screaming, but neither seemed to inflict any physical damage on the other. "They can scratch each other badly with their fingernails," said Hunter, "and you'll sometimes see males bleeding after one of these fights, but most of the competition seems to be in the chase, in getting the females to look at you and applaud."

Only when the afternoon turned to dusk did Pete get a reprieve. Monica was one of the first geladas to retire for the night. She led the way to an escarpment as sheer as the Empire State Building and nimbly dropped over the rocky cliffs to find a sleeping ledge. Pete was close on her heels.

Hunter and I followed them to the edge, watching as the geladas scrambled over the cliffs, seemingly oblivious to the dangers of their death-drop haunts. Besides, there was safety here: Leopards and hyenas couldn't attack them on such vertical terrain, and for now at least, bachelors wouldn't pursue them either. Geladas seldom challenge each other on the cliffs at night, and Pete could look forward to a peaceful night.

"First down to the ledges tonight. I bet he's the last one up tomorrow," Hunter said. "And who knows? Maybe it's Monica's strategy to save Pete."

"IT'S HARD TO SAY what exactly pushes the females to drop their family male," Hunter said the next morning. We had hiked back to the cliffs where we'd last seen Monica and Pete and were waiting for them to reappear. As Hunter had anticipated, they were not among the early risers. Below us, geladas jumped over the cliffs like rock-climbing jocks, some making a beeline for the upper meadows where we were seated, others sitting and warming themselves on a sunny boulder as several youngsters leaped about in the branches of a heath tree. "Usually it's because the male isn't as attentive as the females want him to be. That's especially true in families where there are six or seven females; it's a lot of work to keep them all happy." Quarrels typically erupt among the females, too, when a takeover is under way. Some, like the lower ranked Monica, may want to keep the old male, while others may be ready for a new fellow. Once the decision is made, the females simply rise en masse and sit beside their chosen mate.

Whether or not that would be Pete's fate remained to be seen. Takeover battles could last days or weeks, and even when a family male's demise seemed inevitable, Hunter found it impossible to predict the outcome.

"It looks to me as if Pete could be tossed out, maybe even today," Hunter mused. "But I don't fully understand that young bachelor we saw yesterday. Why was he by himself? Usually a young guy needs his buddies backing him up to succeed. Where were they?"

Hunter kept track of two key groups of bachelors. He called them the Jets and the Sharks after the rival gangs in *West Side Story*. We didn't see either group until later that morning, but when the Jets arrived, Hunter's appellation made immediate sense. There were six bachelors in the Jets, ranging in age from five to eight years, and they were as cocky, boisterous, and proud as their namesakes. They paraded past the feeding geladas, then took up a position on the high ground among some rocks and rose bushes and studied the families below.

Though they live in small family units, geladas prefer the strength of numbers. Nearly 600 animals were now gathered in the meadow before us. The green carved spires of the Simens rose above the glade. A small forest of heath trees edged the meadow, and yellow-flowered

Saint-John's-wort trees cast pools of shade over the lawn.

Mornings and late afternoons are the prime times for gelada social activities—for mating, arguing, and flirting. Pete and Monica had yet to appear (Hunter speculated that they had sneaked around the cliffs, trying to avoid the Jets), but the bachelors were already busy testing the dominant males in other families, looking for points of weakness. Three bachelors moved down the slope, casually feeding but keeping their eyes on two females that had come closer to them.

"Look at that. The hussies!" Hunter teased. "They are absolutely flirting."

In gelada society there is one underlying law that governs all behaviors: Girls Rule.

None of the family males looked directly at the bachelors but instead shot them little side-glances now and then. "Everyone knows what everyone else is doing," Hunter said. "They all know this game."

A few moments later the game erupted when the bachelors inched closer to the two females. The family male came barreling up to their position and raced past them, his mane dancing in the wind. All six Jets joined together in a line and followed him across the meadow, barking at him until he leaped into a flowering tree. The bachelors then sat below him silently while he made a loud "I'm king of the mountain" yelp. He broke off a branch, waved it in the air, then trotted back to his wayward females. Unlike Pete's consorts, this fellow's wives gave him a quick grooming.

"It's a very ritualized display," Hunter said. "Leading the chase is a way for the family male to show he's still the top dog and for the bachelors and his wives to assess his fitness." Only when the bachelors saw some sign of weakness would they begin to focus on an individual family male, as had happened with Pete.

There was, however, another route for bachelors to take to the top. They could become follower males, as Hunter terms them. "It's the sneaky sniveler's way," said Hunter, who was not the least bit sympathetic to this strategy.

It was easy to spot the followers. They usually sat on a family unit's periphery, well away from the family male and close to a young friend, generally a two-year-old youngster in the family. Followers make friends with such youngsters by grooming them. Once a bachelor has successfully ingratiated himself, it is impossible for the family male to get rid of him since the follower generally has his young friend close at hand. "All he has to do is hold up the kid," Hunter said. "No family male would dare hit him then. He'd be ousted on the spot." Over time the follower works to lure away the females' loyalty by always siding with them or the youngsters in any family dispute. "It's cowardly, but it works," Hunter said. "They inevitably become the family male for awhile."

No male lasts more than four years in the top slot, and many lose their title before three. In that sense Pete was already close to the end of his reign.

Over the next few days we kept as close to Pete and Monica as we could, expecting any minute that the young, brassy-haired male of the first night would reappear to claim his title. That never happened. Instead, one morning Pete appeared early on top of the cliffs—walking on all fours, as a gelada normally does. Monica led him to the meadow, and Pete kept close beside her, shoulder to shoulder, in a proud strut.

"I can't believe this is going to have a happy Hollywood ending," Hunter said, laughing. "How did he manage to recover? Has Monica been protecting him?"

They were the kind of teaser questions that melodramas—and long, involved primate sagas—end with.

But like any soap opera, the answers would only come to those who waited and watched, and I was leaving camp the next day. A month went by, and at last I received an e-mail from Hunter: "Pete's hand healed completely! He's with Monica and his family, but things are still a bit shaky. He's not out of the woods yet as far as Cathy is concerned, and she's been flirting with one of the Jets." In other words, all was as it should be in geladaland. □

MORE ON OUR WEBSITE

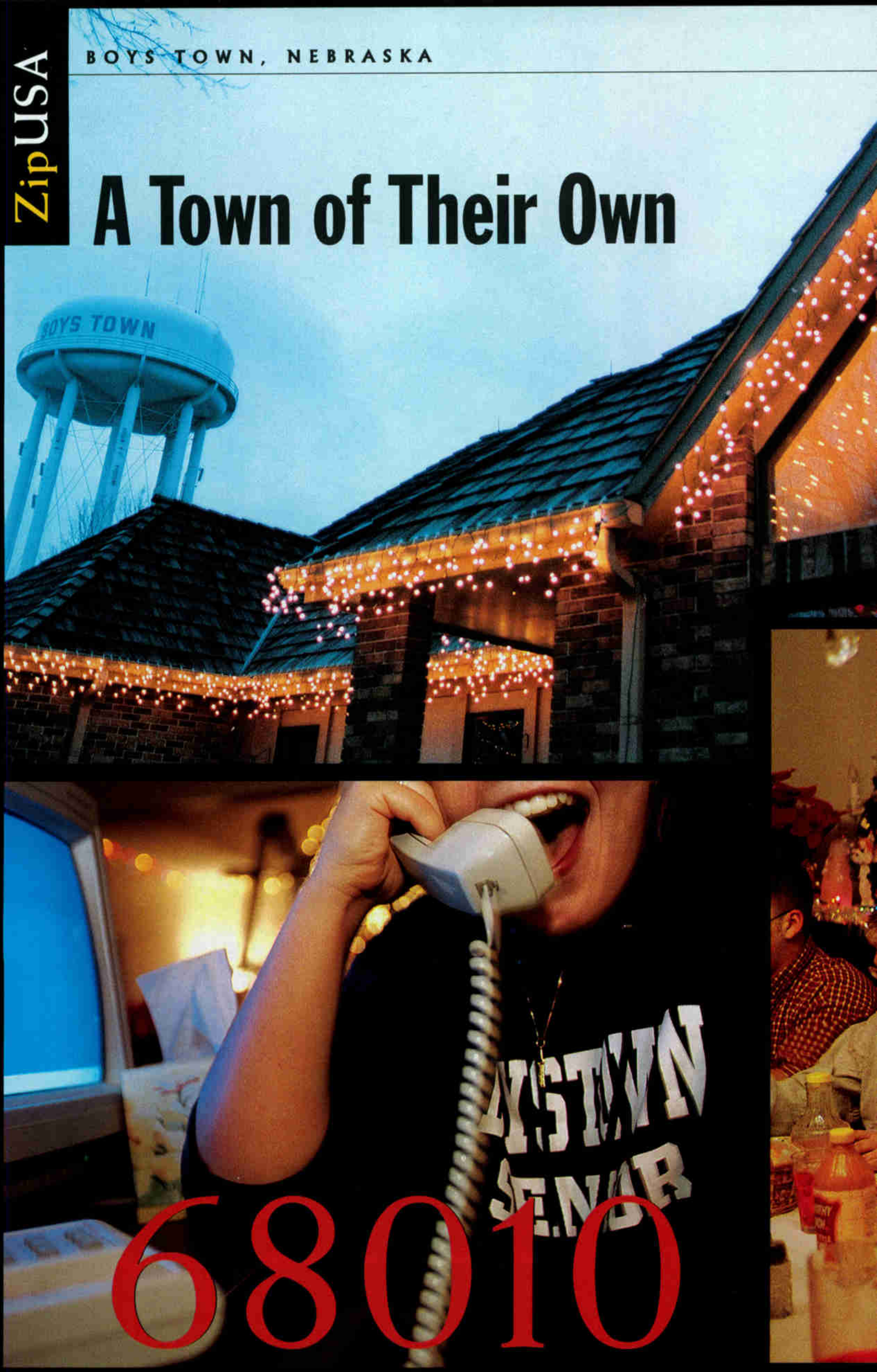
Find out the latest news about Pete, then catch a Sights & Sounds presentation of gelada behavior and natural history at **nationalgeographic.com/ngm/0211**.

Head flung back as if to howl, the monkey merely yawns. His concealed fangs and red chest say he's on top—at least until a male with bigger teeth or a badder attitude overthrows his regime. But looks deceive. "Male geladas are just peacocks," says Hunter. "There's no question who really runs the show."

ZipUSA

BOYS TOWN, NEBRASKA

A Town of Their Own



Bright lights, small town—full of big houses of kids with big troubles. Some want to go home. Others *are* home in this town where "every adult's purpose is to help kids," says Father Val Peter (serving up post-Thanksgiving vittles, bottom). A blast of brass. A phone chat. Another chance at youth.

BY JENNIFER STEINBERG NATIONAL GEOGRAPHIC WRITER

PHOTOGRAPHS BY LANDON NORDEMAN

Group homes hug the main drag of the 900-acre village. A sprint away, the Field House gym, upper right, is a prime hangout.

Straddling dirt bikes, pants crotches to their knees, three teenage boys eye me from a streetlamp's cone of light. City-trained, I look away, walk faster, then glance back. They smile and wave.

It's my first reminder that I'm in a town like no other—Boys Town, Nebraska, the famed village-style haven for troubled kids. Forget Spencer Tracy taming a rogue Mickey Rooney in the 1938 film *Boys Town.* These are real kids with real, sad histories: broken homes, neglect, abuse, drugs, alcohol, psych wards, detention centers, and suicide attempts. Sent here by courts or relatives, all the kids "come in angry," says executive director Father Val Peter. "But we give them back their childhoods, teach them skills, and give them love."

It was another man of the cloth, in 1917, who planted the seed with his motto: "There are no bad boys. There is only bad environment, bad training, bad example, bad thinking." Father Edward Flanagan, with a $90 loan, placed his first five youths in a rented Omaha house. He later borrowed more to buy the 160-acre Overlook Farm, and homeless boys flocked there. A trust fund, donations, and fees paid by state agencies and some parents or guardians have kept the town going—and growing.

The first girls enrolled in 1979 and now make up half the population of what is still called Boys Town, though Girls and Boys Town has become the name of its far-reaching national organization. Flanked by cornfields, highways, then houses to the horizon, Boys Town leans against Omaha's sprawl but retains its identity as a campus of sorts—with 500 kids, a middle school and high school, two churches, a park and post office, police and fire stations, athletic facility and fields, and the iconic statue of one boy shouldering the weight of another.

"Don't ask them about their pasts," Father Peter and others instruct me when I arrive Thanksgiving week. Let them focus on the present, they say: on school, surrogate families, and a rather lengthy set of rules.

Rules here, in fact, rule, the kids tell me. Worship services are mandatory. So is good behavior, which earns points—translating to privileges like candy or outings. Bad behavior (from skipped chores to violent tantrums) means "lost privs" or a stay at the Respite House—where offenders go to cool down. Boys' hair must be short. There's no dating,

TYPICAL POPULATION: 500 kids ages 8-18 (half girls; 63% Protestant, 32% Catholic, 5% other); 138 parent-teachers

AVERAGE STAY: 18 months

COLLEGE-BOUND: 66%

HIGH SCHOOL SPORTS TEAMS: 12 (football team made 2001 state play-offs)

TYPICAL GROCERY BILL: $1,000-plus per household per month

CALLS TO GIRLS AND BOYS TOWN CRISIS HOTLINE SINCE IT OPENED IN 1989: 5 million

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no tank tops, no tight jeans. Piercings are limited to girls, to ears, and no more than two holes per. And so on. Without these laws of the land, "we'd be distracted from what we've come here to do," one girl tells me.

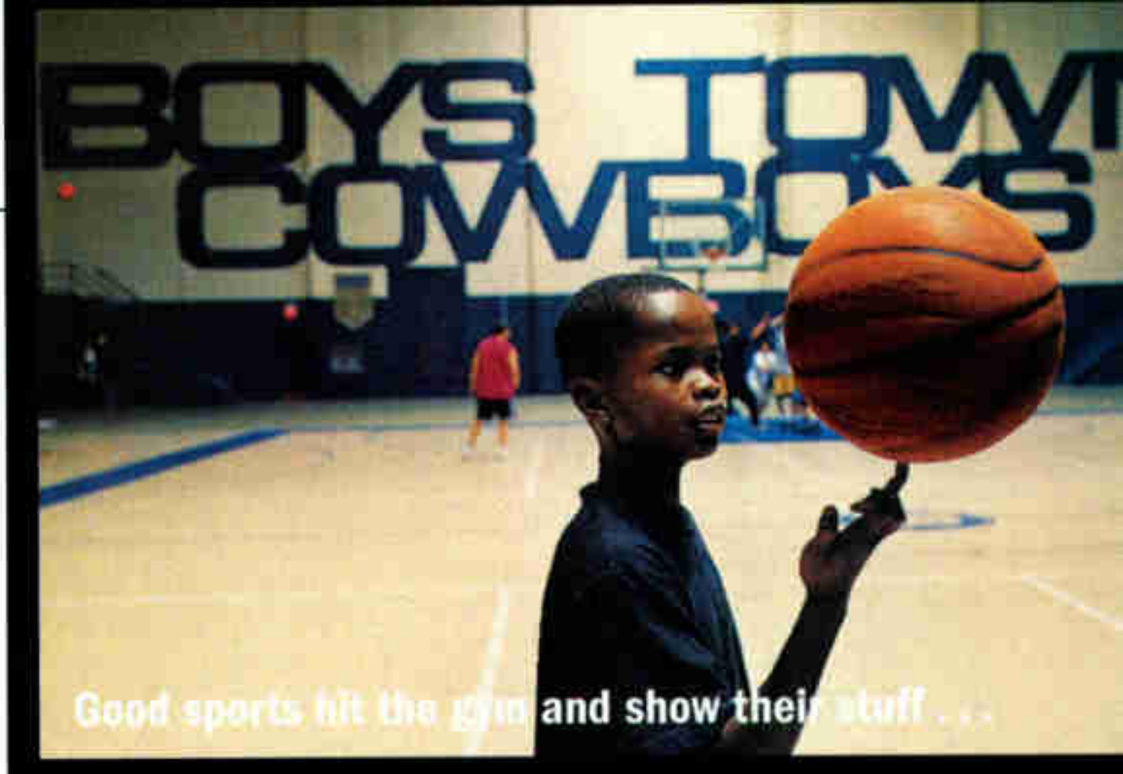
In part, they're here for months or even years of therapy that includes a healthy family life. Kids stay in mixed-race, same-sex groups of six to eight overseen by parent-teachers, resident married couples who are not just rule enforcers but caring supporters and role models. The dorms of earlier days have given way to 69 Tudor houses perched on curving lanes. Welcome flags whip in the wind, surnames dangle from lampposts: The Reals. The Carls. The Joneses.

I've barely stepped into the Jones foyer before I'm politely accosted with handshakes from five teenage boys—clearly in training. "They like the response they get and soon it becomes natural," says parent-teacher Tony Jones, who, with wife Simone, oversees eight teens and his own young son. Once a student here himself, Tony says, "Boys Town saved my life, so I came back to help the next generation."

Blocks away, Scott and Trisha Carl's house of girls represents the other half. Ashley, a sweet-faced freshman, is the first to befriend me. Running from room to room in her socks, she points proudly to family photos. "That's me. And I'm in this one too." Upstairs, her shared room is neat (a recent habit), and her months-old welcome balloon hovers at waist level, shriveled. "I'm keeping it until I leave," she says.

Jennifer—Ashley's roommate—and twin sister Dawn are cheerleader-pretty and busy in the town choir, ROTC, and flag corps (choreographed waving of oversized pennants, which they demonstrate for me in the foyer). "I'm not in all that," Ashley says, curling up in an overstuffed chair, "but I used to be afraid of water and now I swim." Once rebellious ("It's hard to be good when you don't care about yourself") and still reticent to smile, she has dreams of a safe household, a faithful marriage, and maybe a child "once I'm older and more in control."

But here, now, Ashley has "issues" to address. It's Thanksgiving morning and she's antsy; guests, most notably her mother, are coming. "We're working to have a better relationship," she tells me. And in the Carl living room the two do seem, at first, cautious. Then Ashley's mother brushes hair from her daughter's forehead and compliments her attitude change (at home last Christmas, she tells me, Ashley refused to leave her room). Before the feast—a group effort born from the well-rigged kitchen—mother and daughter hold hands as Ashley offers a prayer "for all



Good sports hit the gym and show their stuff . . .


get tie tips from the Joneses before church . . .


share kitchen duties, sisters for a time . . .


iron out their own wrinkles . . .


call football plays—losing some, winning some.

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PUBLIC TRANSPORTATION

Wherever life takes you

who are hurting." And what are the Carl girls thankful for this year? "My parent-teachers," most declare. "That I'm in a safe place" is a close second. "If I weren't here, I'd probably be dead," one says.

Enter Father Peter, a man in constant motion. Today he'll breeze into every house with an infectious laugh and compliments to the chefs. "His visit is a Thanksgiving ritual," says Scott Carl. He and Trisha love their jobs, this place, these kids. "We get to protect them for a little while," Trisha says, forking up sweet potatoes.

There are, of course, bitter moments. Back at the Joneses, the big meal devoured and dishes done, stone-faced Frankie, 12, holds the greasy turkey wishbone out to Tony. "I wish I could go home," Frankie announces, looking at no one, and snaps off the bulk of the bone. Unsmiling, he walks out with his prize. "We can't and don't try to replace their families," Tony tells me later. "And some days they just want out. No surprise there."

Still, every day is a Thanksgiving of sorts for someone in this town, where new kids are made "citizens" in a festive ceremony. The Monday after the holiday, I join eight scrubbed newcomers waiting to face a cafeteria crowd. "I don't want to be here. I'd rather be with my real family," mumbles a straight-banged, suit-clad boy named John. "Better here than in jail," says the kid to his left. Then it's time. Father Peter stands and bids all welcome, cracks a corny joke or two, then calls on the kids to speak. Each rises and recites a rushed stream of well-rehearsed words, as heartfelt as one might expect from teens forced to the podium: *My name is Joe. I've been here for two weeks. What I like best so far are the basketball courts. What I don't like is the point system. What I need to work on is controlling my anger.* And so on. There's applause, and tense faces relax. No longer labeled bad kids, patients, or prisoners, all are deemed citizens and pledge to follow Boys Town's rules—to treat others as brothers and sisters, study hard, play fair, and pray well. "You are now part of our family," Father Peter announces.

Along the way a weary half smile has tweaked John's lips. I point it out to him. "I feel much better," he admits. "Now it's real—I'm part of something." The smile wins out. "I'm no longer an outsider." □

Every day is a Thanksgiving of sorts for someone in this town.

MORE INFORMATION

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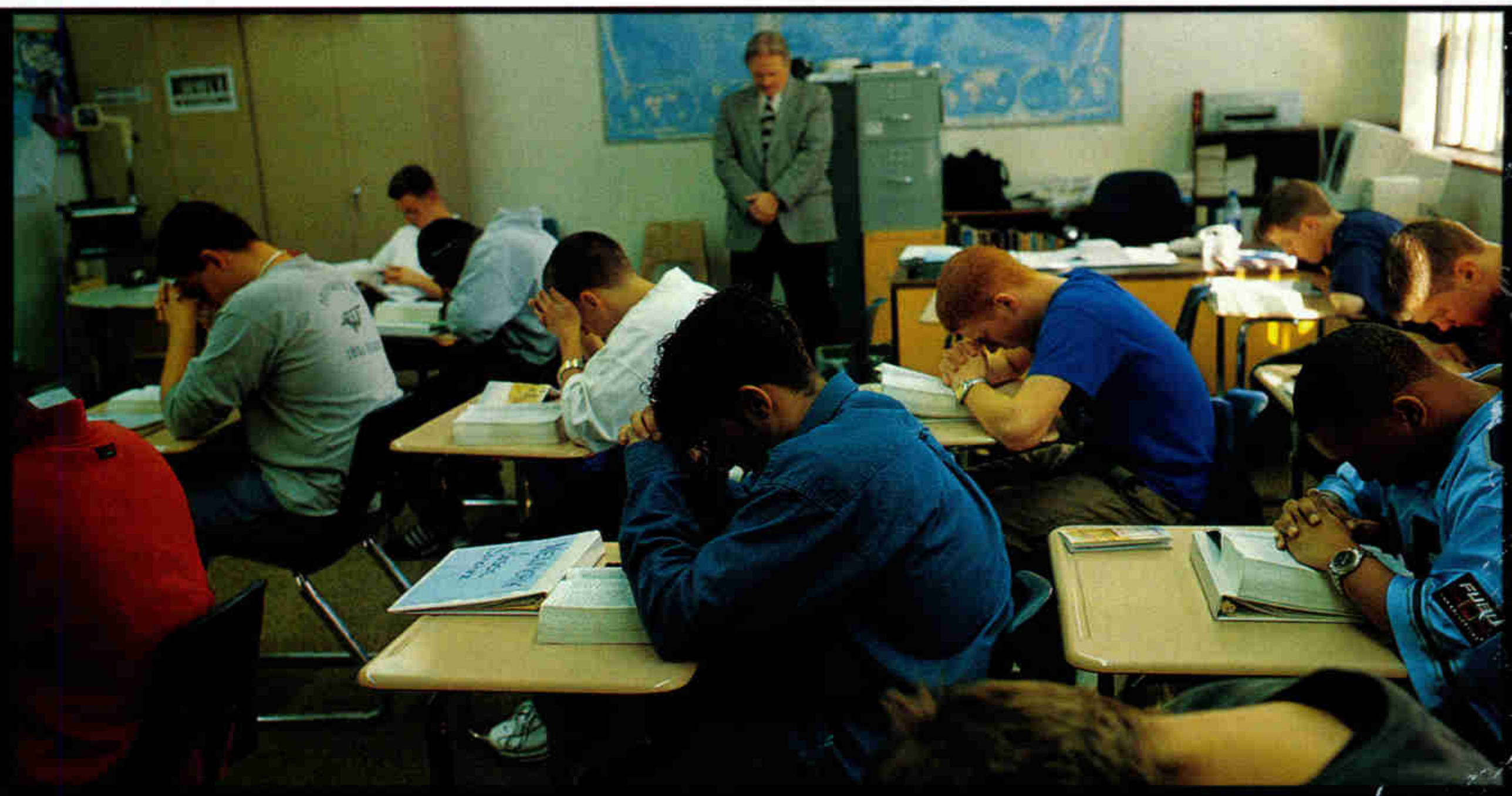

"Every boy must learn to pray," taught founder Father Flanagan. "How he prays is up to him."

Photograph by Todd Gipstein

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Final Edit

NATIONAL GEOGRAPHIC PHOTOGRAPHER MICHAEL NICHOLS

GELADAS

Free Ride

Once they're three months old, geladas ride their mothers jockey-style. Females have just four or five babies in a lifetime but invest a lot of time and energy taking care of them—it's a "quality, not quantity" strategy, says biologist Chadden Hunter, who has spent parts of the past six years with the animals in Ethiopia.

Hunter can't understand why this picture was selected for Final Edit. "It's a mundane shot," he complains—not a surprising reaction, given all the picturesque sex and violence in the gelada's behavioral repertoire. But there's something about the way the tails intertwine. Says Editor in Chief Bill Allen, "I hated to lose this shot of the wonderful bond that any parent knows."

MORE ON OUR WEBSITE

Cut it or keep it? Find out what tipped the balance for this photo and send it as an electronic greeting card at **nationalgeographic.com/ngm/0211.**

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Please see important information on the following page.

*Source™ Prescription Audit (SPA); February 2001 - January 2002. Scott-Levin, Inc.

FLONASE®
(fluticasone propionate)
Nasal Spray, 50 mcg

BRIEF SUMMARY

For Intranasal Use Only. **SHAKE GENTLY BEFORE USE.**

The following is a brief summary only; see full prescribing information for complete product information.

CONTRAINDICATIONS

FLONASE Nasal Spray is contraindicated in patients with a hypersensitivity to any of its ingredients.

WARNINGS

The replacement of a systemic corticosteroid with a topical corticosteroid can be accompanied by signs of adrenal insufficiency, and in addition some patients may experience symptoms of withdrawal, e.g., joint and/or muscular pain, lassitude, and depression. Patients previously treated for prolonged periods with systemic corticosteroids and transferred to topical corticosteroids should be carefully monitored for acute adrenal insufficiency in response to stress. In those patients who have asthma or other clinical conditions requiring long-term systemic corticosteroid treatment, too rapid a decrease in systemic corticosteroids may cause a severe exacerbation of their symptoms.

The concomitant use of intranasal corticosteroids with other inhaled corticosteroids could increase the risk of signs or symptoms of hypercorticism and/or suppression of the hypothalamic-pituitary-adrenal (HPA) axis.

Persons who are using drugs that suppress the immune system are more susceptible to infections than healthy individuals. Chickenpox and measles, for example, can have a more serious or even fatal course in susceptible children or adults using corticosteroids. In children or adults who have not had these diseases or been properly immunized, particular care should be taken to avoid exposure. How the dose, route, and duration of corticosteroid administration affect the risk of developing a disseminated infection is not known. The contribution of the underlying disease and/or prior corticosteroid treatment to the risk is also not known. If exposed to chickenpox, prophylaxis with varicella zoster immune globulin (VZIG) may be indicated. If exposed to measles, prophylaxis with pooled intramuscular immunoglobulin (IG) may be indicated. (See the respective package inserts for complete VZIG and IG prescribing information.) If chickenpox develops, treatment with antiviral agents may be considered.

Avoid spraying in eyes.

PRECAUTIONS

General: Intranasal corticosteroids may cause a reduction in growth velocity when administered to pediatric patients (see PRECAUTIONS: Pediatric Use).

Rarely, immediate hypersensitivity reactions or contact dermatitis may occur after the administration of FLONASE Nasal Spray. Rare instances of wheezing, nasal septum perforation, cataracts, glaucoma, and increased intraocular pressure have been reported following the intranasal application of corticosteroids, including fluticasone propionate.

Use of excessive doses of corticosteroids may lead to signs or symptoms of hypercorticism and/or suppression of HPA function.

Although systemic effects have been minimal with recommended doses of FLONASE Nasal Spray, potential risk increases with larger doses. Therefore, larger than recommended doses of FLONASE Nasal Spray should be avoided.

When used at higher than recommended doses or in rare individuals at recommended doses, systemic corticosteroid effects such as hypercorticism and adrenal suppression may appear. If such changes occur, the dosage of FLONASE Nasal Spray should be discontinued slowly consistent with accepted procedures for discontinuing oral corticosteroid therapy.

In clinical studies with fluticasone propionate administered intranasally, the development of localized infections of the nose and pharynx with *Candida albicans* has occurred only rarely. When such an infection develops, it may require treatment with appropriate local therapy and discontinuation of treatment with FLONASE Nasal Spray. Patients using FLONASE Nasal Spray over several months or longer should be examined periodically for evidence of *Candida* infection or other signs of adverse effects on the nasal mucosa.

Intranasal corticosteroids should be used with caution, if at all, in patients with active or quiescent tuberculous infections of the respiratory tract; untreated local or systemic fungal or bacterial infections; systemic viral or parasitic infections; or ocular herpes simplex.

Because of the inhibitory effect of corticosteroids on wound healing, patients who have experienced recent nasal septal ulcers, nasal surgery, or nasal trauma should not use a nasal corticosteroid until healing has occurred.

Information for Patients: Patients being treated with FLONASE Nasal Spray should receive the following information and instructions. This information is intended to aid them in the safe and effective use of this medication. It is not a disclosure of all possible adverse or intended effects.

Patients should be warned to avoid exposure to chickenpox or measles and, if exposed, to consult their physician without delay.

Patients should use FLONASE Nasal Spray at regular intervals for optimal effect. Some patients (12 years of age and older) with seasonal allergic rhinitis may find as-needed use of 200 mcg once daily effective for symptom control (see Clinical Trials section of full prescribing information).

A decrease in nasal symptoms may occur as soon as 12 hours after starting therapy with FLONASE Nasal Spray. Results in several clinical trials indicate statistically significant improvement within the first day or two of treatment; however, the full benefit of FLONASE Nasal Spray may not be achieved until treatment has been administered for several days. The patient should not increase the prescribed dosage but should contact the physician if symptoms do not improve or if the condition worsens.

For the proper use of FLONASE Nasal Spray and to attain maximum improvement, the patient should read and follow carefully the patient's instructions accompanying the product.

Drug Interactions: In a placebo-controlled, crossover study in 8 healthy volunteers, coadministration of a single dose of orally inhaled fluticasone propionate (1,000 mcg; 5 times the maximum daily intranasal dose) with multiple doses of ketoconazole (200 mg) to steady state resulted in increased mean fluticasone propionate concentrations, a reduction in plasma cortisol AUC, and no effect on urinary excretion of cortisol. This interaction may be due to an inhibition of cytochrome P450 3A4 by ketoconazole, which is also the route of metabolism of fluticasone propionate. No drug interaction studies have been conducted with FLONASE Nasal Spray; however, care should be exercised when fluticasone propionate is coadministered with long-term ketoconazole and other known cytochrome P450 3A4 inhibitors.

Carcinogenesis, Mutagenesis, Impairment of Fertility: Fluticasone propionate demonstrated no tumorigenic potential in mice at oral doses up to 1,000 mcg/kg (approximately 20 times the maximum recommended daily intranasal dose in adults and approximately 10 times the maximum recommended daily intranasal dose in children on a mcg/m^2 basis) for 78 weeks or in rats at inhalation doses up to 57 mcg/kg (approximately 2 times the maximum recommended daily intranasal dose in adults and approximately equivalent to the maximum recommended daily intranasal dose in children on a mcg/m^2 basis) for 104 weeks.

Fluticasone propionate did not induce gene mutation in prokaryotic or eukaryotic cells in vitro. No significant clastogenic effect was seen in cultured human peripheral lymphocytes in vitro or in the mouse micronucleus test.

No evidence of impairment of fertility was observed in reproductive studies conducted in male and female rats at subcutaneous doses up to 50 mcg/kg (approximately 2 times the maximum recommended daily intranasal dose in adults on a mcg/m^2 basis). Prostate weight was significantly reduced at a subcutaneous dose of 50 mcg/kg.

Pregnancy: ***Teratogenic Effects:*** Pregnancy Category C. Subcutaneous studies in the mouse and rat at 45 and 100 mcg/kg, respectively (approximately equivalent to and 4 times the maximum recommended daily intranasal dose in adults on a mcg/m^2 basis, respectively) revealed fetal toxicity characteristic of potent corticosteroid compounds, including embryonic growth retardation, omphalocele, cleft palate, and retarded cranial ossification.

In the rabbit, fetal weight reduction and cleft palate were observed at a subcutaneous dose of 4 mcg/kg (less than the maximum recommended daily intranasal dose in adults on a mcg/m^2 basis).

However, no teratogenic effects were reported at oral doses up to 300 mcg/kg (approximately 25 times the maximum recommended daily intranasal dose in adults on a mcg/m^2 basis) of fluticasone propionate to the rabbit. No fluticasone propionate was detected in the plasma in this study, consistent with the established low bioavailability following oral administration (see CLINICAL PHARMACOLOGY section of full prescribing information).

Fluticasone propionate crossed the placenta following oral administration of 100 mcg/kg to rats or 300 mcg/kg to rabbits (approximately 4 and 25 times, respectively, the maximum recommended daily intranasal dose in adults on a mcg/m^2 basis).

There are no adequate and well-controlled studies in pregnant women. Fluticasone propionate should be used during pregnancy only if the potential benefit justifies the potential risk to the fetus.

Experience with oral corticosteroids since their introduction in pharmacologic, as opposed to physiologic, doses suggests that rodents are more prone to teratogenic effects from corticosteroids than humans. In addition, because there is a natural increase in corticosteroid production during pregnancy, most women will require a lower exogenous corticosteroid dose and many will not need corticosteroid treatment during pregnancy.

Nursing Mothers: It is not known whether fluticasone propionate is excreted in human breast milk. However, other corticosteroids have been detected in human milk. Subcutaneous administration to lactating rats of 10 mcg/kg of tritiated fluticasone propionate (less than the maximum recommended daily intranasal dose in adults on a mcg/m^2 basis) resulted in measurable radioactivity in the milk. Since there are no data from controlled trials on the use of intranasal fluticasone propionate by nursing mothers, caution should be exercised when FLONASE Nasal Spray is administered to a nursing woman.

Pediatric Use: Five hundred (500) patients aged 4 to 11 years and 440 patients aged 12 to 17 years were studied in US clinical trials with fluticasone propionate nasal spray. The safety and effectiveness of FLONASE Nasal Spray in children below 4 years of age have not been established.

Controlled clinical studies have shown that intranasal corticosteroids may cause a reduction in growth velocity in pediatric patients. This effect has been observed in the absence of laboratory evidence of HPA axis suppression, suggesting that growth velocity is a more sensitive indicator of systemic corticosteroid exposure in pediatric patients than some commonly used tests of HPA axis function. The long-term effects of this reduction in growth velocity associated with intranasal corticosteroids, including the impact on final adult height, are unknown. The potential for "catch-up" growth following discontinuation of treatment with intranasal corticosteroids has not been adequately studied. The growth of pediatric patients receiving intranasal corticosteriods, including FLONASE Nasal Spray, should be monitored routinely (e.g., via stadiometry). The potential growth effects of prolonged treatment should be weighed against the clinical benefits obtained and the risks/benefits of treatment alternatives. To minimize the systemic effects of intranasal corticosteroids, including FLONASE Nasal Spray, each patient should be titrated to the lowest dose that effectively controls his/her symptoms.

Geriatric Use: A limited number of patients 65 years of age and older (n =129) or 75 years of age and older (n=11) have been treated with FLONASE Nasal Spray in US and non-US clinical trials. While the number of patients is too small to permit separate analysis of efficacy and safety, the adverse reactions reported in this population were similar to those reported by younger patients.

ADVERSE REACTIONS

In controlled US studies, more than 3,300 patients with seasonal allergic, perennial allergic, or perennial nonallergic rhinitis received treatment with intranasal fluticasone propionate. In general, adverse reactions in clinical studies have been primarily associated with irritation of the nasal mucous membranes, and the adverse reactions were reported with approximately the same frequency by patients treated with the vehicle itself. The complaints did not usually interfere with treatment. Less than 2% of patients in clinical trials discontinued because of adverse events; this rate was similar for vehicle placebo and active comparators.

Systemic corticosteroid side effects were not reported during controlled clinical studies up to 6 months' duration with FLONASE Nasal Spray. If recommended doses are exceeded, however, or if individuals are particularly sensitive or taking FLONASE Nasal Spray in conjunction with administration of other corticosteroids, symptoms of hypercorticism, e.g., Cushing syndrome, could occur.

The following incidence of common adverse reactions (>3%, where incidence in fluticasone propionate-treated subjects exceeded placebo) is based upon 7 controlled clinical trials in which 536 patients (57 girls and 108 boys aged 4 to 11 years, 137 female and 234 male adolescents and adults) were treated with FLONASE Nasal Spray 200 mcg once daily over 2 to 4 weeks and 2 controlled clinical trials in which 246 patients (119 female and 127 male adolescents and adults) were treated with FLONASE Nasal Spray 200 mcg once daily over 6 months. Also included in the table are adverse events from 2 studies in which 167 children (45 girls and 122 boys aged 4 to 11 years) were treated with FLONASE Nasal Spray 100 mcg once daily for 2 to 4 weeks.

Overall Adverse Experiences With >3% Incidence on Fluticasone Propionate in Controlled Clinical Trials With FLONASE Nasal Spray in Patients ≥4 Years With Seasonal or Perennial Allergic Rhinitis

Adverse Experience	Vehicle Placebo (n=758) %	FLONASE 100 mcg Once Daily (n=167) %	FLONASE 200 mcg Once Daily (n=782) %
Headache	14.6	6.6	16.1
Pharyngitis	7.2	6.0	7.8
Epistaxis	5.4	6.0	6.9
Nasal burning/ nasal irritation	2.6	2.4	3.2
Nausea/vomiting	2.0	4.8	2.6
Asthma symptoms	2.9	7.2	3.3
Cough	2.8	3.6	3.8

Other adverse events that occurred in ≤3% but ≥1% of patients and that were more common with fluticasone propionate (with uncertain relationship to treatment) included: blood in nasal mucus, runny nose, abdominal pain, diarrhea, fever, flu-like symptoms, aches and pains, dizziness, bronchitis.

Observed During Clinical Practice: In addition to adverse events reported from clinical trials, the following events have been identified during postapproval use of fluticasone propionate in clinical practice. Because they are reported voluntarily from a population of unknown size, estimates of frequency cannot be made. These events have been chosen for inclusion due to either their seriousness, frequency of reporting, or causal connection to fluticasone propionate or a combination of these factors.

General: Hypersensitivity reactions, including angioedema, skin rash, edema of the face and tongue, pruritus, urticaria, bronchospasm, wheezing, dyspnea, and anaphylaxis/anaphylactoid reactions, which in rare instances were severe.

Ear, Nose, and Throat: Alteration or loss of sense of taste and/or smell and, rarely, nasal septal perforation, nasal ulcer, sore throat, throat irritation and dryness, cough, hoarseness, and voice changes.

Eye: Dryness and irritation, conjunctivitis, blurred vision, glaucoma, increased intraocular pressure, and cataracts.

Cases of growth suppression have been reported for intranasal corticosteroids, including FLONASE (see PRECAUTIONS: Pediatric Use).

OVERDOSAGE

Chronic overdosage may result in signs/symptoms of hypercorticism (see PRECAUTIONS). Intranasal administration of 2 mg (10 times the recommended dose) of fluticasone propionate twice daily for 7 days to healthy human volunteers was well tolerated. Single oral doses up to 16 mg have been studied in human volunteers with no acute toxic effects reported. Repeat oral doses up to 80 mg daily for 10 days in volunteers and repeat oral doses up to 10 mg daily for 14 days in patients were well tolerated. Adverse reactions were of mild or moderate severity, and incidences were similar in active and placebo treatment groups. Acute overdosage with this dosage form is unlikely since 1 bottle of FLONASE Nasal Spray contains approximately 8 mg of fluticasone propionate.

The oral and subcutaneous median lethal doses in mice and rats were >1,000 mg/kg (>20,000 and >41,000 times, respectively, the maximum recommended daily intranasal dose in adults and >10,000 and >20,000 times, respectively, the maximum recommended daily intranasal dose in children on a mg/m^2 basis).

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BOYS TOWN

Justice on Their Side

Keeping up with the Jones kid

His name is Justice Jones, and he's the three-year-old son of parent-teachers Tony and Simone at Boys Town. Justice took to author **Jennifer Steinberg** —maybe because she didn't hesitate to join him for upside-down acrobatics. "He didn't treat me like an adult," she says, "and I wanted to keep it that way." Playing with Justice was therapeutic for Jenny after a week of reporting, but is even more so for the eight troubled boys who share the child's home. "He gives them something they need," Jenny says, "a loving little brother and unconditional friend."

GNMENT

COVERING THE WORLD

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WEAPONS

A Nightmare Job

LYNN JOHNSON

Photographer **Lynn Johnson** (right, at right) and **Ludmila Mekertycheva,** the magazine's interpreter (and researcher, diplomat, fixer, and therapist) in the former Soviet Union, had just toured a biological research institute in southern Kazakhstan. "It has everything dastardly: anthrax, plague, Q fever," Lynn recalls. "Everyone had to change into a clean suit, which probably wasn't protective in any way; if you got those biohazards in your respiratory system, this little bunny suit wouldn't help." Afterward, Lynn and Luda forced smiles into the mirror in the women's changing room. "When you're in a situation so depressing, all you can do is find refuge in the relationships you have on the road," Lynn says.

Preparing an article on weapons of mass destruction began to wear on Lynn, Luda, and author **Lewis Simons.** "We all had trouble sleeping at night and weird dreams," says Lynn. At a former Soviet nuclear test site, Lynn was making photographs and Lew was taking notes while Luda anxiously watched radiation monitors. "She watched the needle go higher and higher; clearly we were in a hot area," Lynn says. "You know how photographers are: I said, 'Just a few more pictures.' She said, '*Now!* You have to come out of there *now.*' It was not a good place to be."

WORLDWIDE

PRASONG KITTINANTHACHAI

After photographing a woman exfoliating customers' faces on a Bangkok sidewalk for this month's article on skin, **Sarah Leen** (above) tried it herself. "They put a chalky powder on your face, then shave you with a string, taking off the top layer of loose, dead cells. It only hurts near the hairline; afterward your skin feels incredibly silky." At a Buddhist temple Sarah indulged in a Thai massage and took an herbal steam bath after rubbing herself with a grainy mixture of fruits, spices, and herbs ("It turned my skin yellow").

Author **Joel Swerdlow** also offered his face for the story. He served as a guinea pig in his own personal test of a French pharmaceutical firm's antiwrinkle cream. "I didn't notice the lines on my face before," Joel says. "Now when I shave in the morning, I do. That's the gift I got from working on this article."

For the past decade, **Michael "Nick" Nichols** has primarily photographed elusive animals in rain forests, where the goal was simply to "get an animal in the frame." Photographing geladas on the north-central highlands of Ethiopia—in good light, for once—was a pleasant change. "It was more like street photography in a crowded city," Nick says. "There's always something going on: one gelada stepping on another's toe or going for a girl. As long as I sat down, there could be a fight going on, full chaos, and they would never touch me."

Like Nick, **Virginia Morell,** who taught at an Ethiopian university in the mid-1970s, mastered gelada etiquette. "If you didn't stare at them, you were fine," she says. "One day we sat in one spot, and about 700 geladas ambled by. We were like a boulder in a river of geladas. The river would widen as they came to us, then close up again as they went by."

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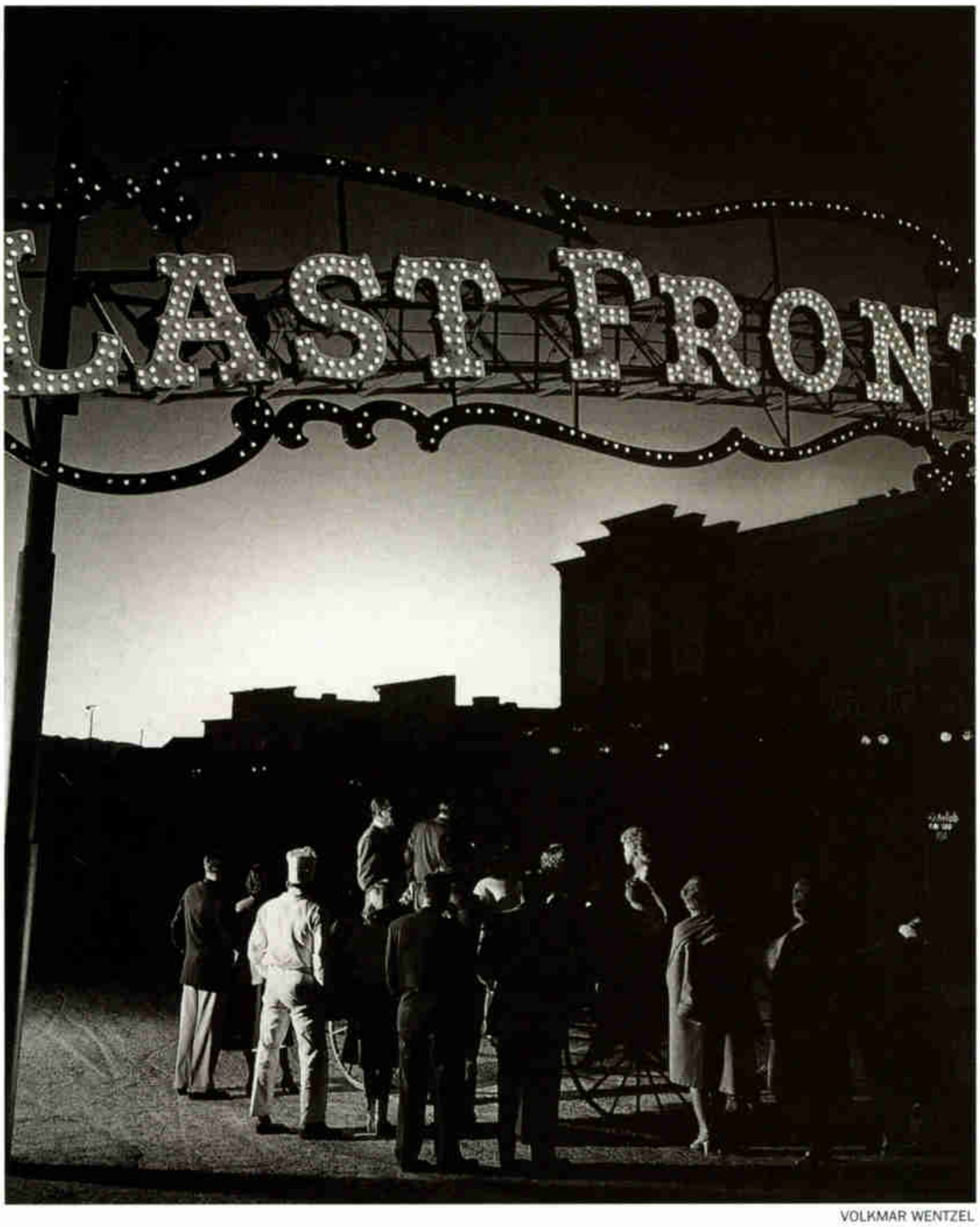

VOLKMAR WENTZEL

WEAPONS OF MASS DESTRUCTION

Nuclear Dawn

The glow of an atomic bomb test at Yucca Flat, Nevada, 65 miles away, draws Las Vegas casino workers on March 17, 1953. The GEOGRAPHIC's Sam Matthews watched from a tarpaper-lined trench just two miles from the explosion. "The atomic fireball rose in the sky, a giant sphere of orange and black, tongues of fire amid billowing soot," he wrote. Though this photo was probably shot for his June 1953 article "Nevada Learns to Live With the Atom," it has never before been published in the magazine.

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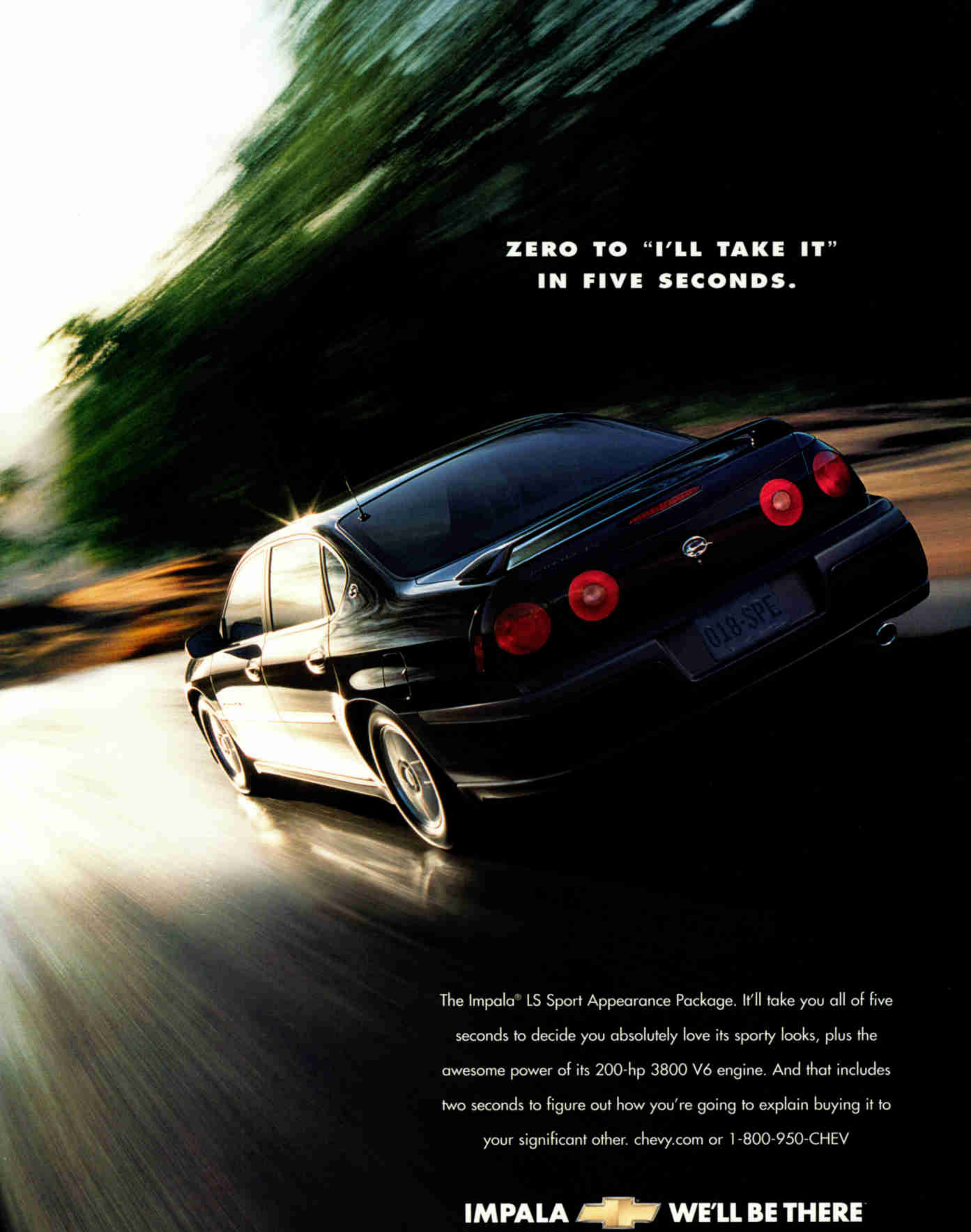

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